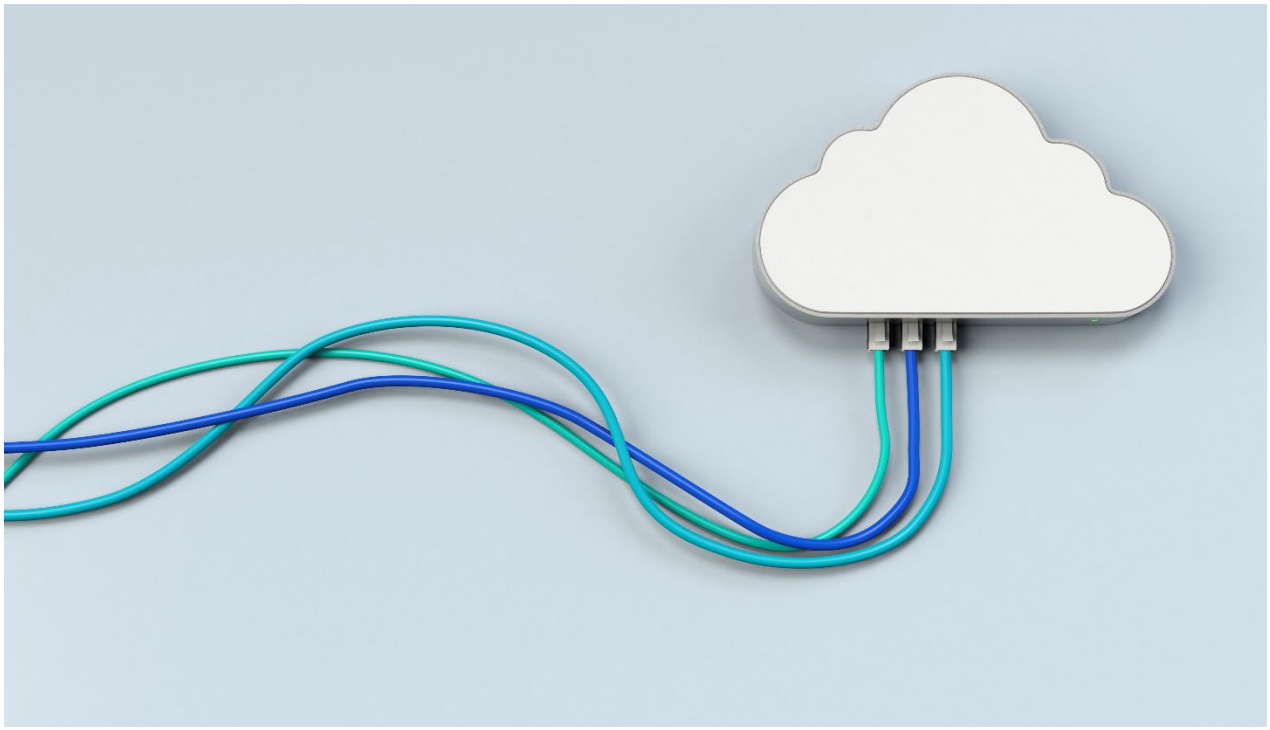

Smart Equipment - IoT

G-Cloud 13 Framework

Version 1.0 | 18.05.2022

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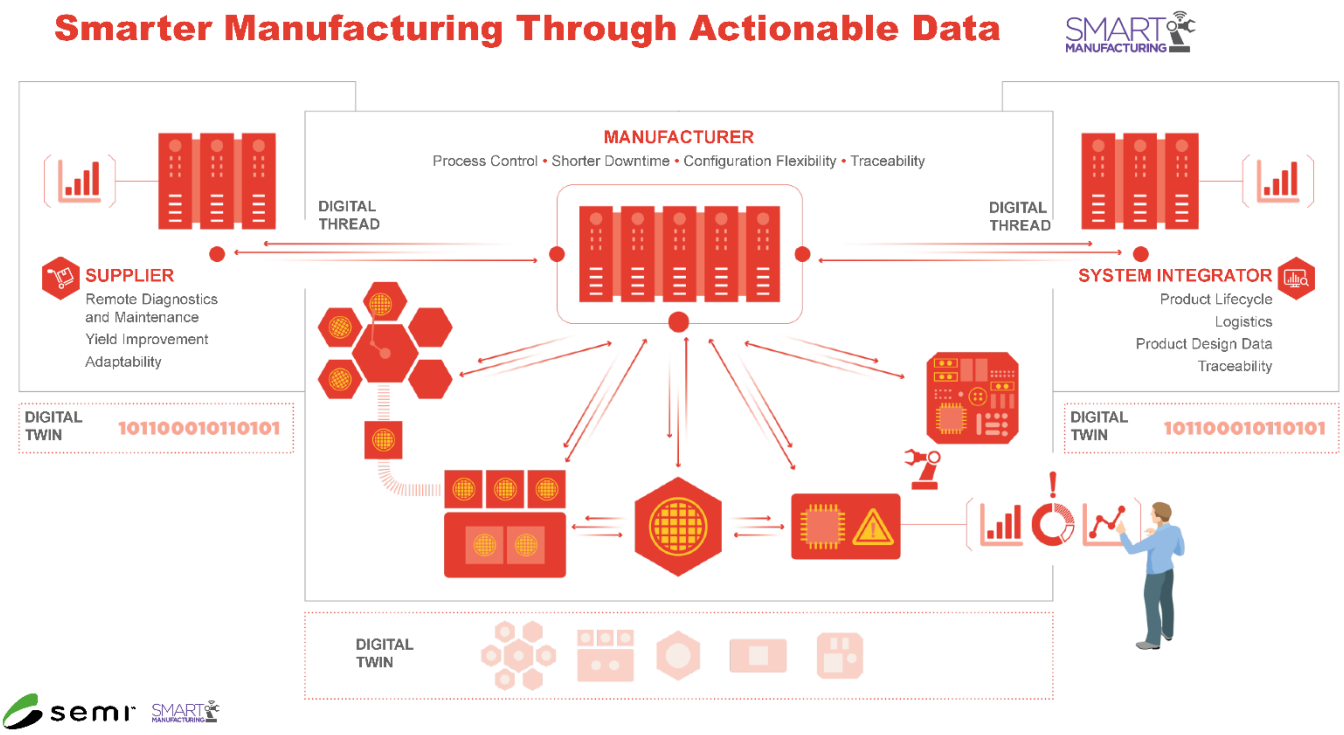
1 Smart Equipment – Overview

1.1 Introduction

Smart equipment and smart equipment systems

The expectations of customers, and business partners alike, are rising rapidly as the world becomes increasingly digitised. A Connected Customer Experience is the new driver for disruption. A big part of that disruption is embodied by the shift towards a new paradigm – Everything-as-a-Service. Product ownership is evolving towards service consumption models where customers only pay for what they use.

A few examples of these include city bicycle rental schemes, coffee machines in offices, and even industrial equipment. Products are getting smarter; equipment is getting smarter and therefore so are the factories and production lines that produce them. The Internet of Things (IoT) is essential for this truly connected world and the first step is understanding service asset conditions.



[NOTE Figure taken from What is Smart Manufacturing | SEMI, UNEP, 2018.]

As equipment manufacturers and business owners, you are met with the continuous challenge of boosting revenue whilst reducing expenses to serve your customers. Creating revenue growth traditionally fell on faster product releases and creating more features to increase sales volumes and prices. While this is still a widely pursued strategy, this does not resolve the largest hurdle that customers face, but, in fact, exacerbates it—cost. In effect, manufacturers pursuing this strategy will see a larger amount of revenue and profit coming

from a smaller group of steadfast and loyal customers and will find acquiring new customers to be increasingly difficult.

Manufacturers who haven't embraced IoT will contest against companies that have managed to gain invaluable data from their equipment regarding everyday processes. These competitors will be able to uncover actionable insights from their data to operate more efficiently.

1.2 Definitions

There are many definitions for Smart Equipment in use globally.

Gartner describes the role of Smart Equipment in Smart Manufacturing as:
Definition of Smart Manufacturing - Gartner Information Technology Glossary

"Smart manufacturing is the notion of orchestrating physical and digital processes within factories and across other supply chain functions to optimize current and future supply and demand requirements. This is accomplished by transforming and improving ways in which people, process and technology operate to deliver the critical information needed to impact decision quality, efficiency, cost, and agility."

NOTE 1: This definition is deliberately presented as a "working definition" rather than intended as a "definitive definition" that should be taken as absolute. While there is a strong degree of commonality among the smart manufacturing strategies that are being developed around the UK, there is also significant diversity.

Smart equipment is complex and encompasses a plethora of industries and use cases. For the equipment to be classified as smart, it needs to holistically address several issues including a) Equipment efficiency; b) Equipment logistics; c) Product quality; d) Product accuracy; e) Equipment precision; f) Informed decisions and g) Transparency.

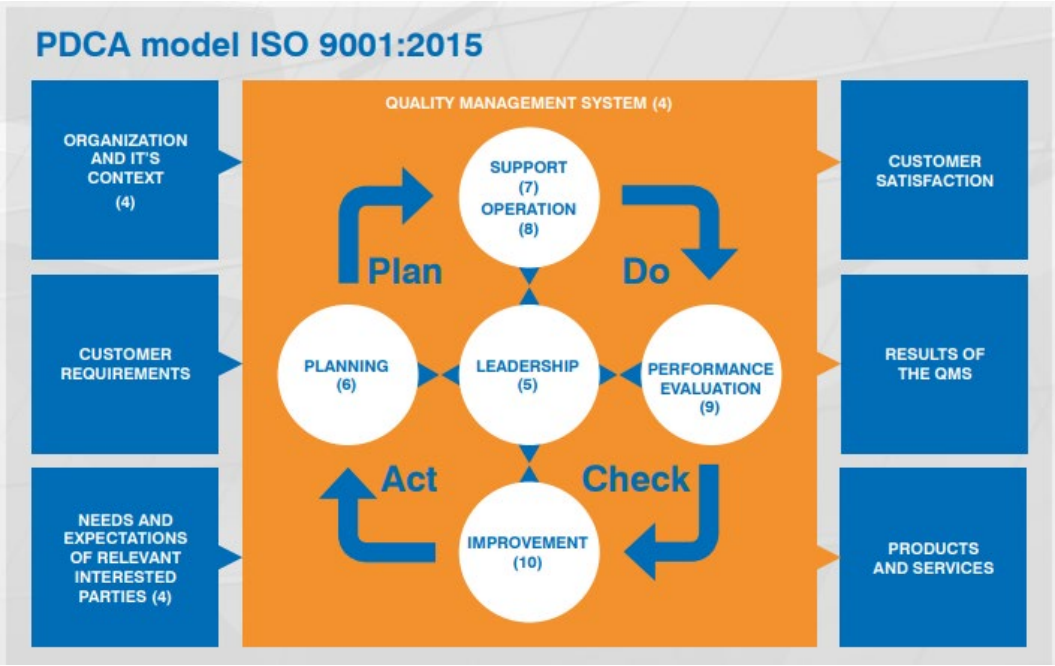
Smart equipment utilises digital systems to communicate with end users and organisational stakeholders, exploiting the data and information for logistical analysis and service delivery. This in turn allows for the nurturing of the required digital skills to streamline service delivery and innovations.

[NOTE Figure taken from View Sonic]

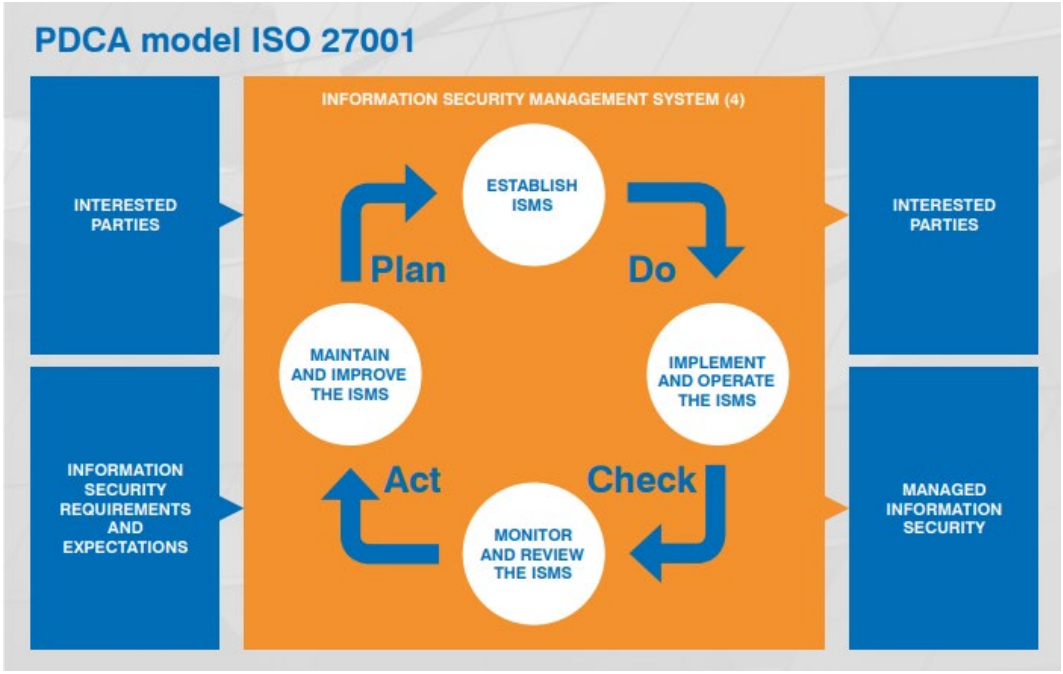
ISO standards provide smart equipment manufacturers with a framework for how they can manage their service via the best business practices and provide the most benefit to their customers whilst meeting their expectations. For example, ISO 9001:2015 sets out guidelines for streamlining the services delivered to customers and addressing internal risks and opportunities. Some of the benefits include saving both time and costs through the identification and encouragement of efficient time saving processes, as well as a reduction in costs through fewer instances of service complaints due to the accentuation of deficiencies.

Another aspect to a smart equipment manufacturer's service is the technical capabilities, which typically have basic requirements for sufficiency (Something customers expect from such a service). ISO provides a framework for manufacturers to meet these requirements when implementing an information security management system.

Safeguarding information assets while making the process easier to manage, measure, and improve. ISO 27001:2013 defines principles for monitoring, reviewing, and maintaining the data of an organisation, keeping it secure in conjunction with retaining its value. Benefits of utilising this framework include Regulatory Compliance, Informed Risk Management as well as a more compelling value proposition for customers.



[NOTE Figure taken from ISO 9001:2015, UNEP, 2015.]



[NOTE Figure taken from ISO 27001:2013, UNEP, 2013.]

Cumulocity IoT for Smart Equipment

The demands of customers and business partners are expanding at a significant rate as the world we live in becomes increasingly smarter. There is a greater requirement for a data driven, connected customer experience as a new vehicle for expansion. Industrial, healthcare and any product manufacturer in general, is seeking greater revenue and customer satisfaction by adding internet-connected capabilities for monitoring and control of smart equipment. To support this shift, products are getting smarter, as are the factories that make them, even the cities we live in too. Manufacturers must diversify their revenue streams from just equipment sales to digital services and software by building smart solutions. This results in more resilient and repeatable revenue streams that don't require direct equipment sales. The Internet of Things and Cumulocity IoT can be key enablers for this new connected world, empowering manufacturers to operate more efficiently and businesses to offer added services.

Smart equipment can collect large amounts of data over time. With the right tools, it can be utilised to analyse trends in availability, performance, and quality in real time. The use of historic data to correlate with actual events can help inform a proactive approach to unexpected scenarios, where data sets match those of a previous historic event. Historical data analysis can uncover large trends in productivity, such as lost production time due to changeovers. For example, with smart equipment you can track trends of your manufacturing lines over time, this can help highlight where losses are occurring within the overall equipment efficiency of your production lines. Allowing you to better understand where improvements must be made. Such insights can assist operators in increasing throughput and yield.

The new potential from sensors on industrial equipment, production lines and factory floors and the sharing of data between these channels, if integrated correctly, will enable users to drive a variety of use cases:

- **Condition Monitoring** – Data driven understanding of equipment performance and condition.
- **Digital Twin** – Digital understanding of equipment performance and simulation of product improvements on performance.
- **Condition based Predictive Maintenance** – Services program based on real-time data driven condition of equipment, not customer notification.
- **Equipment as a Service** - Subscription based sales model for equipment and services.
- **Outcomes based Program** - Your customers pay for usage and outcomes.

Many customers are faced with the constant struggle of increasing revenue while decreasing costs to produce goods. This is no different within the world of manufacturing, they are under pressure to get started with IIoT (Industrial Internet of Things) or risk falling behind as operations and services evolve around them. Equipment manufacturers who have not adopted IIoT will find themselves competing against enterprises that have significantly better cost and revenue structures. These enterprises will be able to offer their customers a more flexible range of purchase and lease options and will be leveraging service programs which operate more efficiently.

Using IoT they will also be able to understand how customers leverage products and features, allowing them to adopt a streamlined approach towards customers based on data. Knowing how and when their equipment is used will empower equipment makers to add key features but also discontinue unused features just as

quickly. Not pursuing an IoT strategy could leave price as the only competitive distinction for manufacturers and will likely require significant reductions to just maintain current revenue levels.

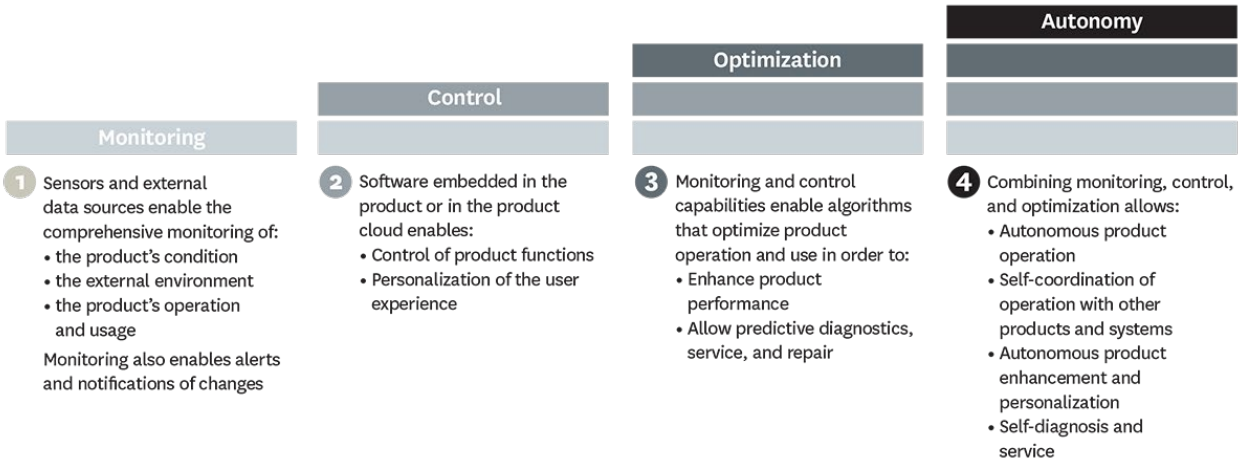
Studies have shown that manufacturers who embrace IoT as a key part of their digital transformation journey not only increase the success of their transformation and level of innovation, but also increase profits through operational cost reduction on the factory floor. McKinsey, a management consulting firm that advises on strategic management to corporations, governments, and other organisations, has shown that remote asset condition monitoring can reduce maintenance costs by 30% and machine downtime by 50%. Their studies have also found that commitment in all relevant change areas increases the chances of transformation success to 79%.

Source:[https://www.mckinsey.com/~/media/mckinsey/industries/advanced%20electronics/our%20insights/capturing%20value%20at%20scale%20in%20discrete%20manufacturing%20with%20industry%204%200/industry-4-0-capturing-value-at-scale-in-discrete-manufacturing-vf.pdf]

There is great value for businesses who can join the dots between smart equipment and IoT:

- **Better Customer Experiences** – Customers can be offered a more compelling product experience which promotes greater loyalty and account growth opportunities.
- **Flexible Models** – Manufacturers will be able to offer their customers more flexible and competitive purchase and service models.
- **Improved Operations** – Smart equipment makers can expect to understand features and usage. Leveraging this data to decrease product release times and improve services.
- **Innovation** – Manufacturers can leverage the IoT platform to develop and deliver innovative new capabilities and business models, disrupting competitors.

The main capabilities of smart, connected products can be categorised into four main classifications according to Harvard Business Review:



- **Monitoring** – Using data, a product can alert users or others to changes in circumstances or performance. Monitoring also allows companies and customers to track a product's operating characteristics and history and to better understand how the product is actually used.

- **Control** – Smart, connected products can be controlled through remote commands or algorithms that are built into the device or reside in the product cloud. Control through software embedded in the product or the cloud allows the customisation of product performance to a degree that previously was not cost effective or often even possible. The same technology also enables users to control and personalise their interaction with the product in many new ways.

- **Optimisation** – Smart, connected products can apply algorithms and analytics to real-time or historical data to dramatically improve output, utilization, and efficiency. Real-time monitoring of data on product condition and product control capabilities enables firms to optimize services. This is done by performing preventative maintenance when failure is imminent and accomplishing repairs remotely, thereby reducing product downtime and the need to dispatch repair personnel. Even when on-site repair is required, prior information about what is broken, what parts are needed, and how to accomplish the fix reduces service costs and improves first-time fix rates.

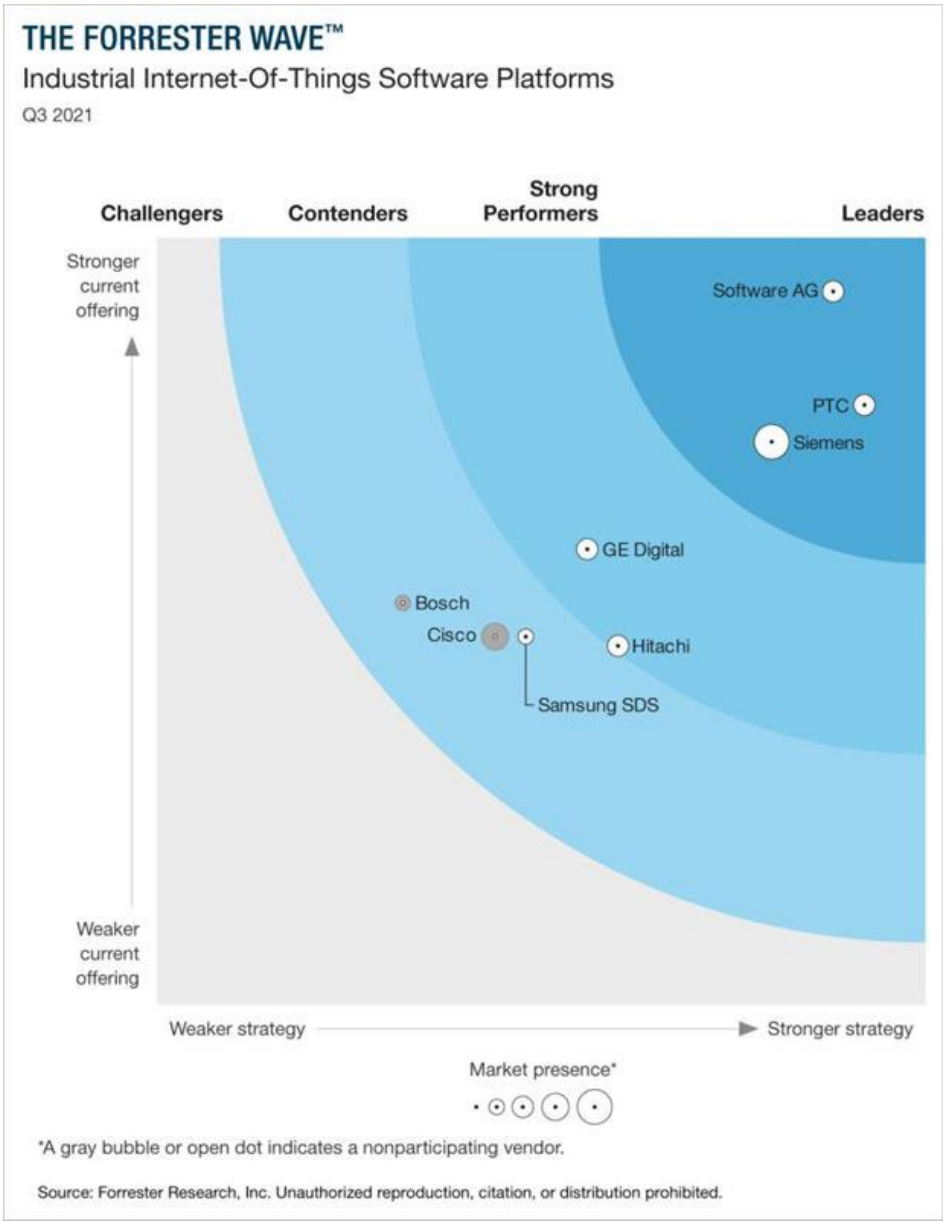
- **Autonomy** - More-sophisticated products are able to learn about their environment, self-diagnose their own service needs, and adapt to users' preferences. Autonomy not only can reduce the need for operators but can improve safety in dangerous environments and facilitate operation in remote locations. Human operators merely monitor performance or watch over the fleet or the system, rather than individual units. Autonomous products can also act in coordination with other products and systems. The value of these capabilities can grow exponentially as more and more products become connected.

Source: Harvard Business Review [How Smart, Connected Products Are Transforming Competition (hbr.org)]

Why Cumulocity?

With Cumulocity IoT, you'll get the most complete platform for device connectivity, management, and visualisation. You will have out of the box connectivity to hundreds of device types and protocols. Cumulocity provides the most advanced, real-time, and predictive analytical capabilities in the market with low code out-of-the-box functionalities designed to accelerate your IoT initiative. Cumulocity also offers the most flexible deployment options with cloud, on-premises, edge, and any hybrid combination. It's world leading Apama streaming analytics engine is capable of analysing huge volumes of data in real time, both in the cloud and at the edge.

Cumulocity is designed to be a fully re-brandable IoT solution, equipment makers and operators can provide a branded, connected experience, tailored to their customers' needs. Market leading capabilities for hybrid integration is also a key strength of Cumulocity, making it possible to connect to 3rd party applications or enterprise systems to share data and integrate processes. Cumulocity IoT gives users very fast visibility and control over remote assets that the user wants to manage.



'Software AG's Cumulocity IoT addresses carrier-grade edge-to-cloud opportunities. Software AG supports industrial customers with the Cumulocity IoT platform, which spans the edge-to-cloud continuum. The platform offers a breadth of wide-area (e.g., 3G, 4G/LTE, and 5G), and short-range wireless connectivity options that is among the most comprehensive in this evaluation.

Software AG also supports an extensive array of industrial IoT protocols relative to other firms we evaluated, complemented by a fully functional Cumulocity IoT edge solution supporting thick and thin environments.'

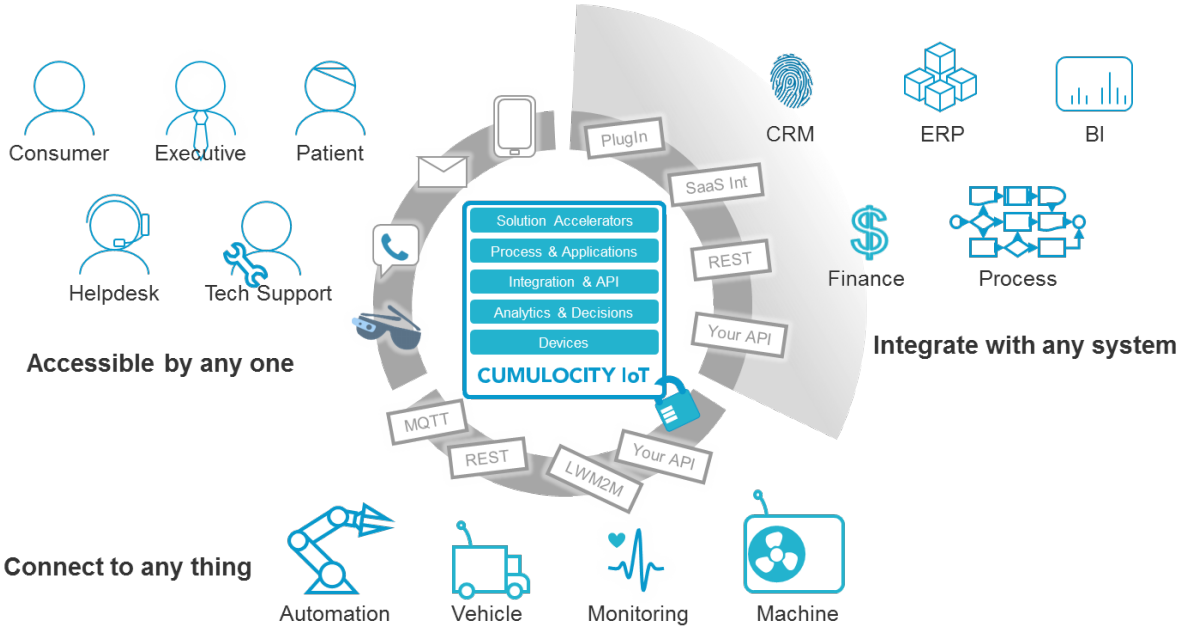
Source: IIoT Forrester Wave Report [IIoT Software Platforms | Forrester Wave Report (softwareag.com)

Software AG and Cumulocity was recognised as a Leader by Forrester in The Forrester Wave™ for IIoT software Platforms. Cumulocity IoT scored 5 out of 5 in 24 of the 35 criterias, including device management, developer enablement, product vision, execution and innovation roadmap, performance, connected devices and many more.

Cumulocity IoT provides

- Certified software libraries which the User can use to bring their remote assets into the cloud.
- Device management, data visualisation and remote-control functionality through the web.
- Rapid customisation of these functionalities through real-time processing and applications.
- APIs for extending the existing functionality or interfacing Cumulocity IoT with other northbound IT services such as ERP or CRM systems. Cumulocity IoT can also host HTML5 applications.

These features are provided through Edge, On-Prem or a cloud-based subscription service making the creation of Internet of Things (IoT) solutions with Cumulocity IoT fundamentally different from bespoke development and RAD (rapid application development). Users can start immediately with a large amount of existing functionality without worrying about piecing the building blocks together. They can also access a Trial for free. With Cloud Option, users do not need to worry about IT infrastructure (hosting, networking, security, storage, and backup) and IT management (all software is available to your users). Cumulocity IoT works with most network connectivity architecture and is specifically designed to work out-of-the-box with mobile networks.



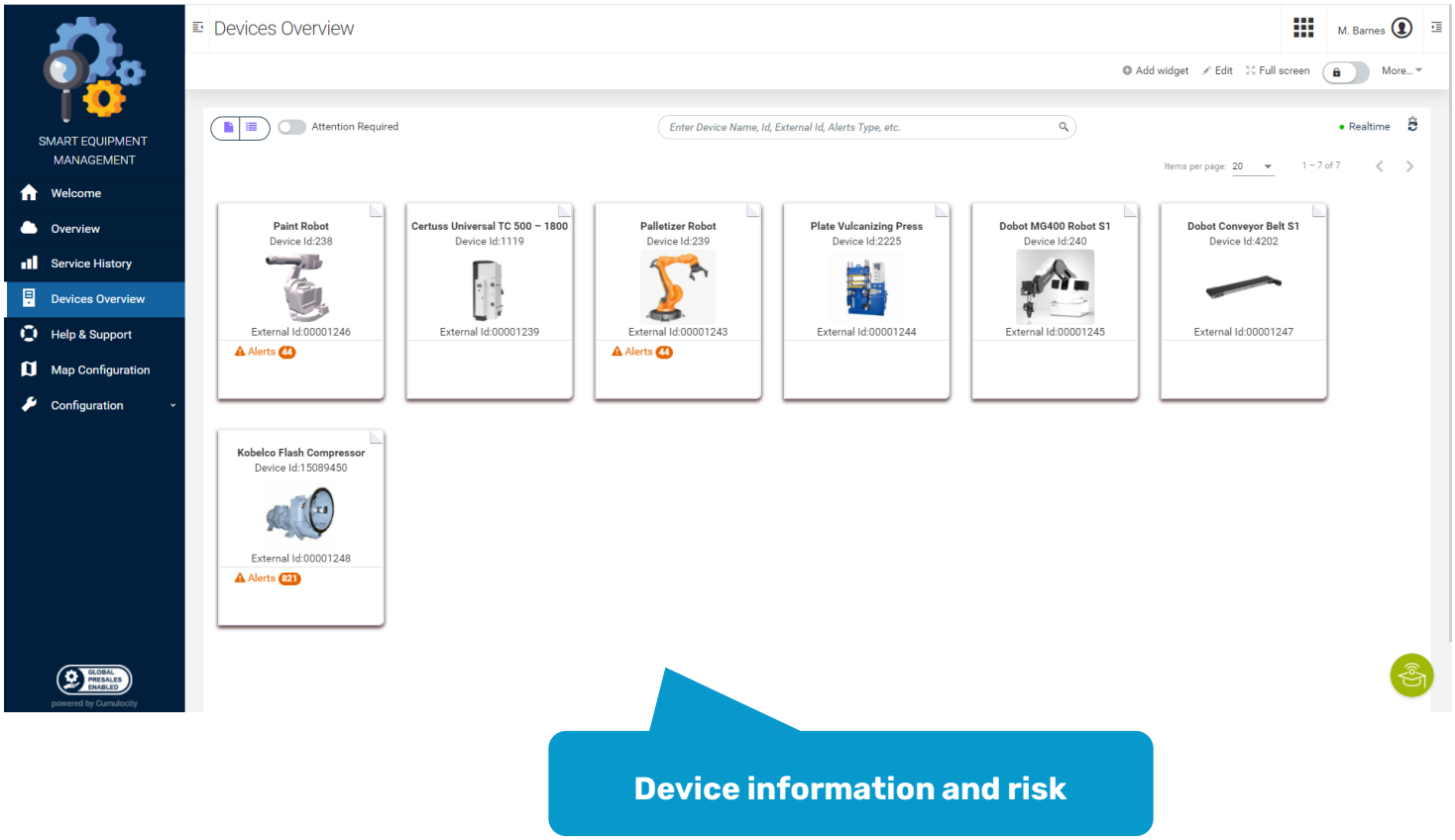
2.1 Visualisation and Remote Control

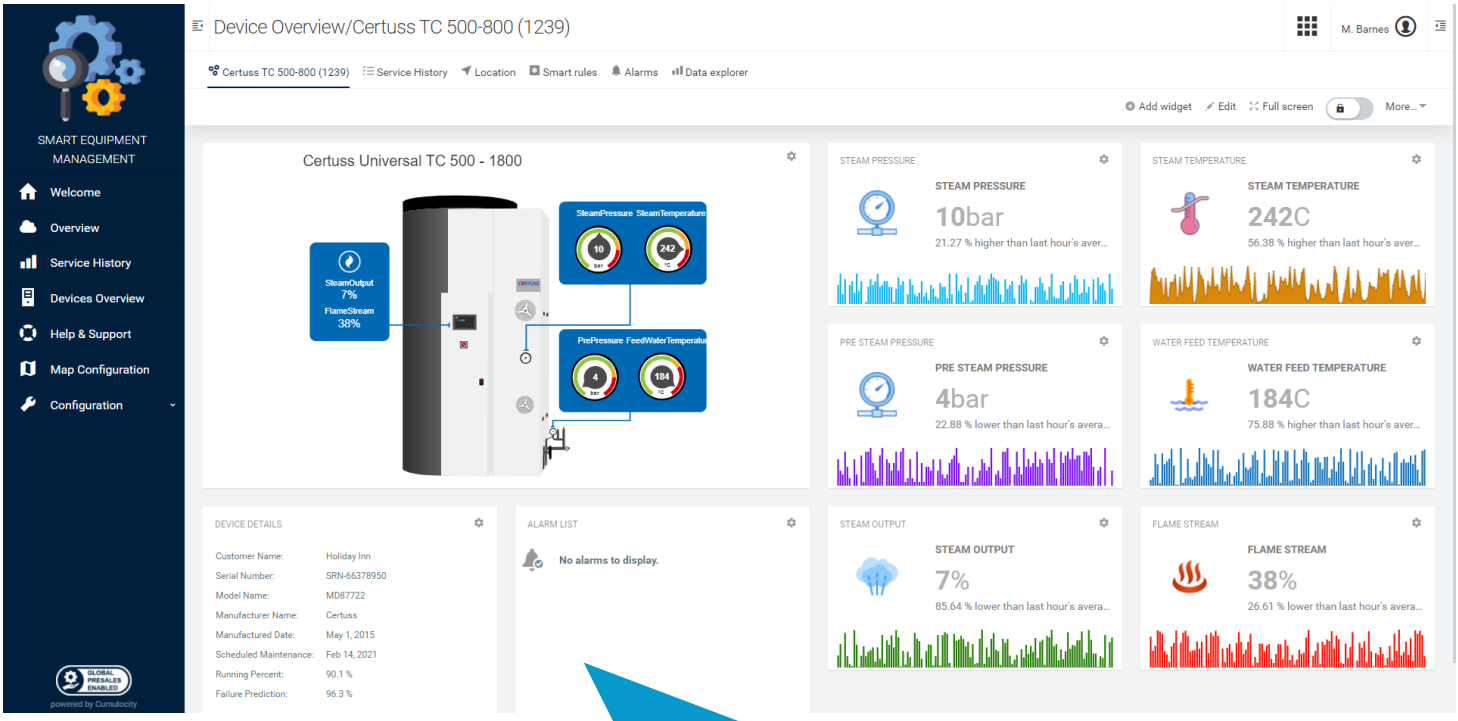
Cumulocity visualises sensor data centrally and graphically through its modern web user interface. It also exposes common remote controls to users who have the relevant permissions.

USP-The user interface automatically adapts itself to the connected devices - no configuration required. For example, a connected device that supports being restarted from remote shows a “Restart” button. If the device sends light sensor data, it shows a graph with the readings from the sensor.

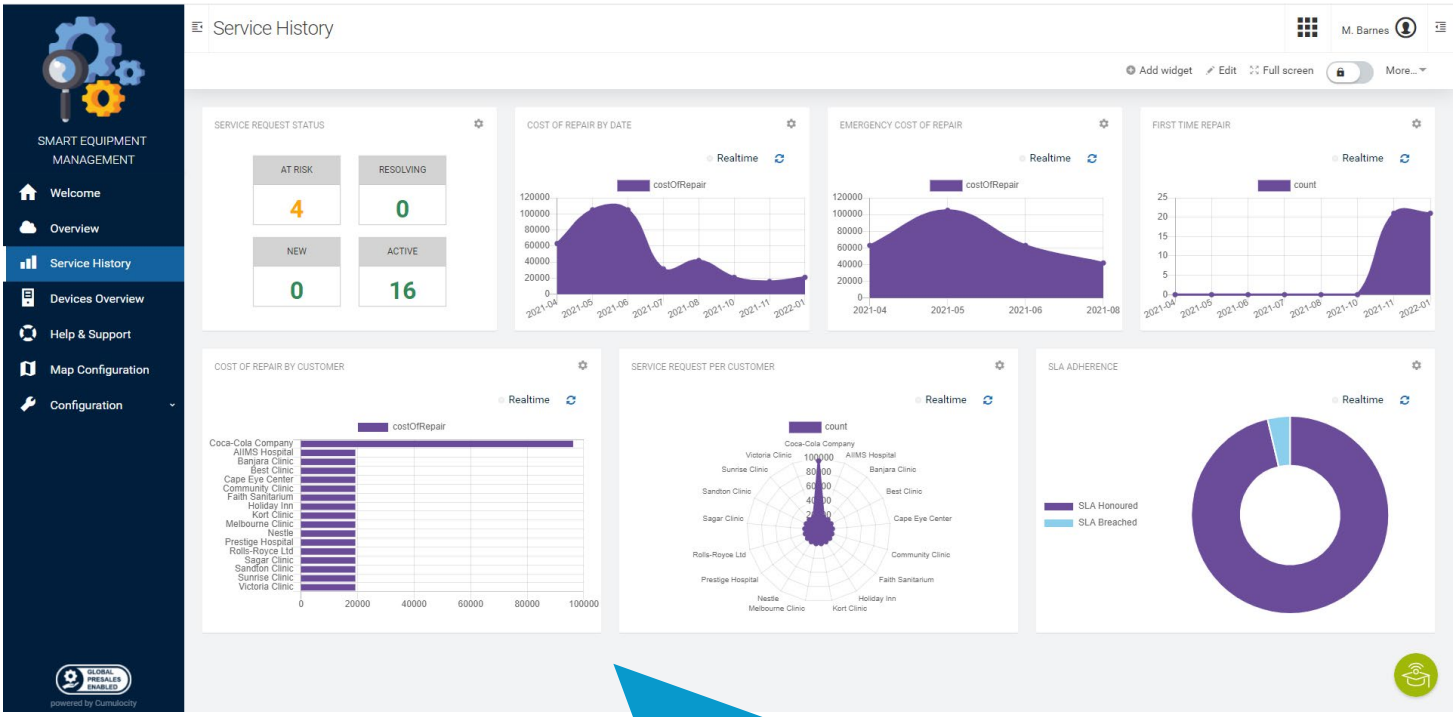
Cumulocity GUI also adapts itself to the web browser that is being used. For example, a mobile phone or tablet with limited screen size, it will change user interface controls to use less screen estate.

Through the Sensor Library, common sensor and control types are rendered correctly regardless of the device that produces the sensor data.





Device details including measurements and service history

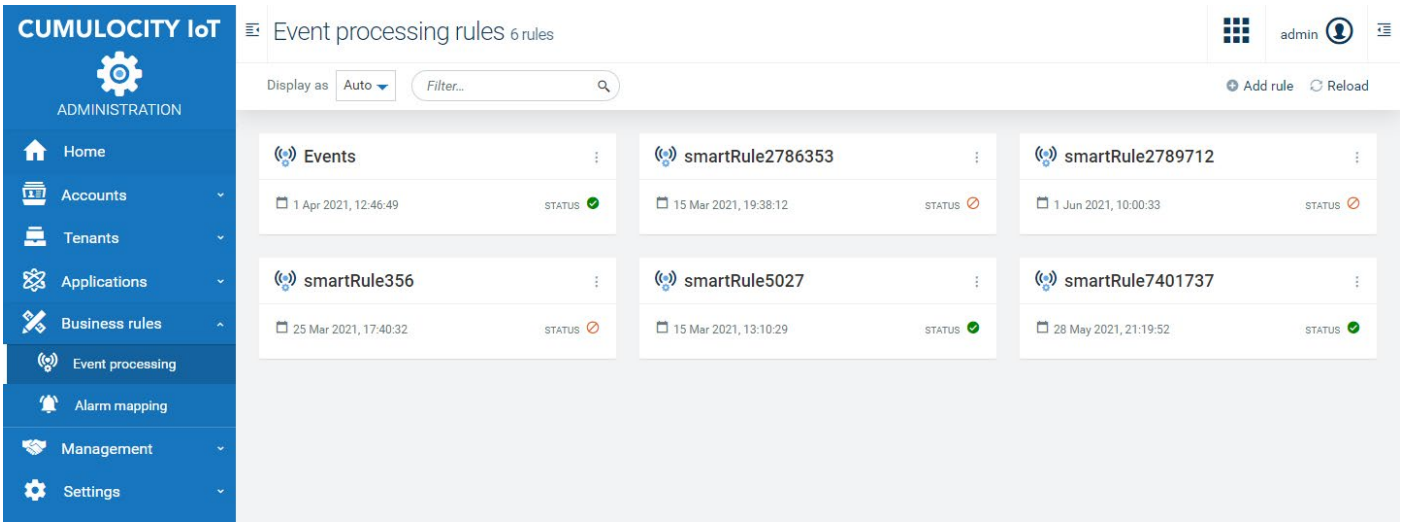


Service program review leveraging integration to your service management system

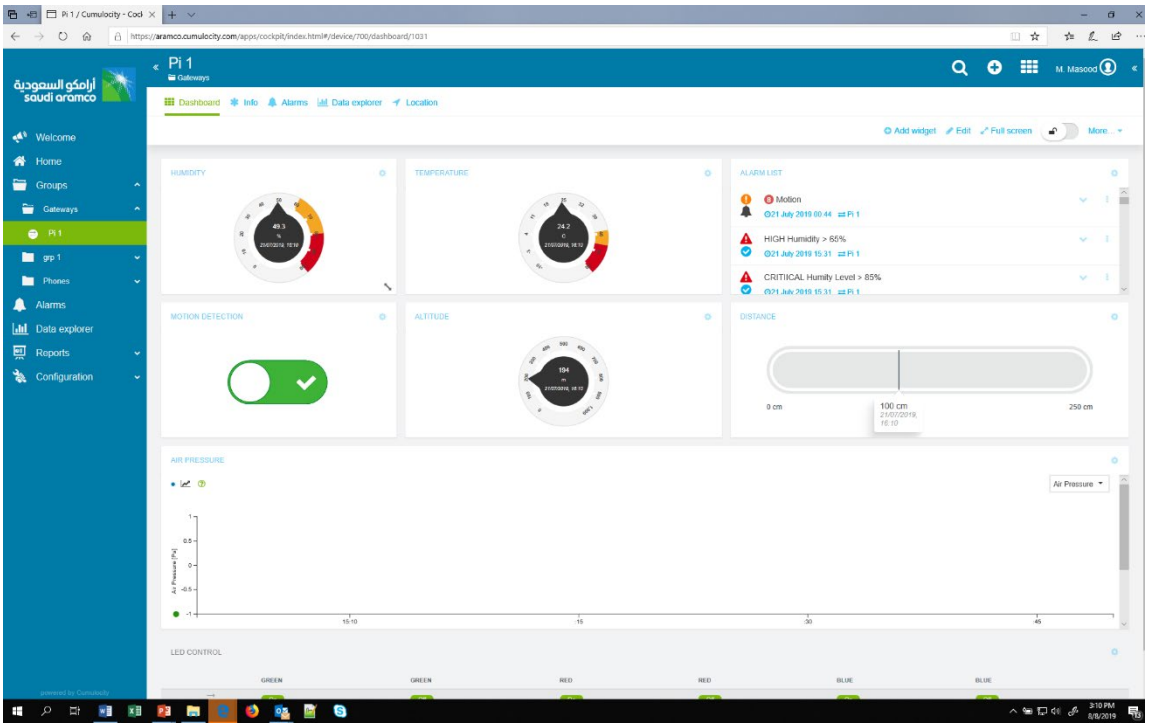
2.2 User Interface Customisation

The functionality described above provides already a wide range of device management, visualisation, and control options. Furthermore, it produces custom visualisation, new control widgets and custom business logic. Cumulocity has extensive customisation options:

- Write alarm rules to reprioritise or suppress alarms and to define SLA parameters
- Use Cumulocity Event Processing Language to implement real-time business rules. For example, get an email when critical events happen, or trigger automated actions on devices in that case
- Set up a graphical dashboard with most important KPIs
- Subscribe to plugins that contribute new functionality to the Cumulocity application.

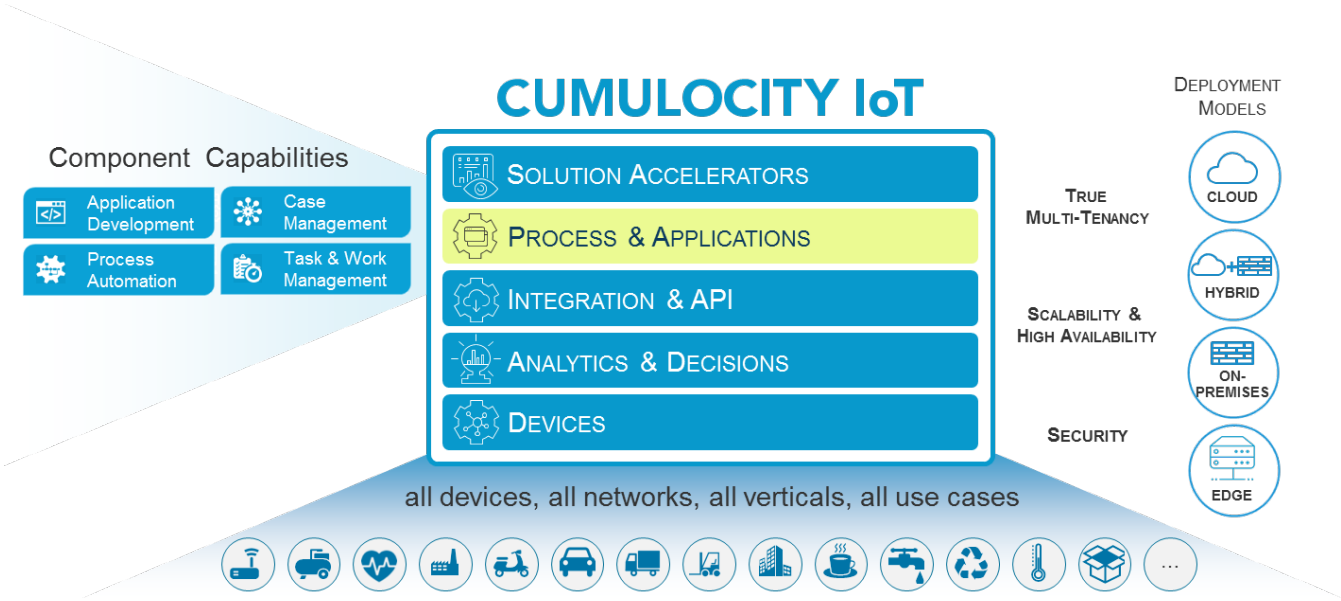


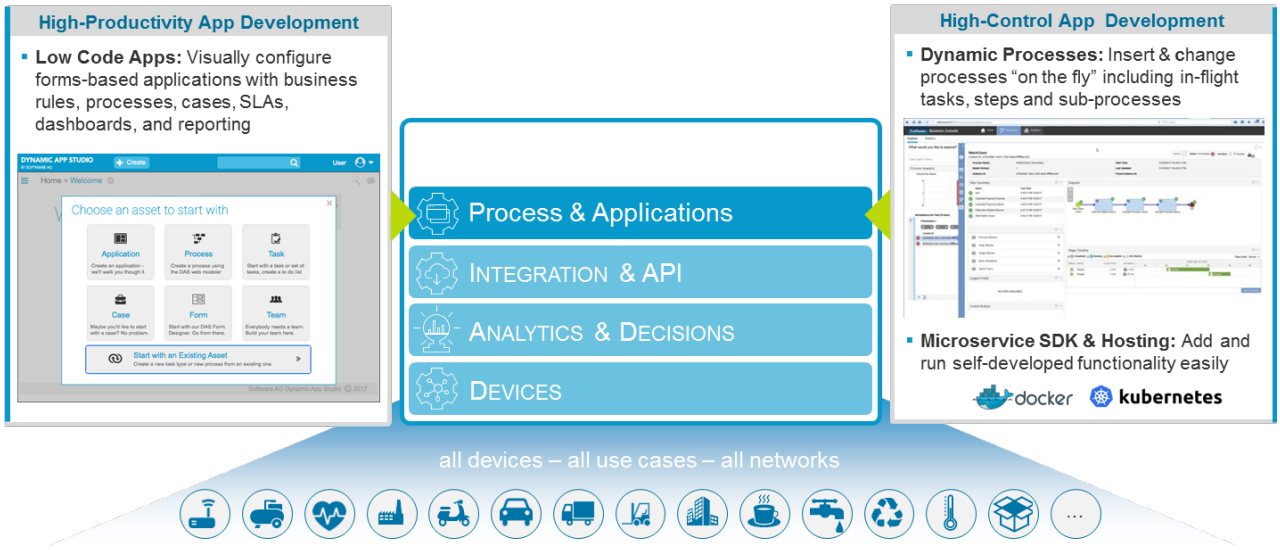
Below is a sample UI customisation for Enterprise. This is for illustration purpose only. Actual customisation will be based on Enterprise specifications & standards. For bespoke customisation of GUI, it should be possible to create a script which queries the Asset Management system and uses this data to populate data and UI structures in Cumulocity.



2.3 Processes & Vertical Applications- Northbound

Any device information received not only needs to be processed but also requires actions to be taken. For this purpose, Cumulocity provides its customers the flexibility to not only integrate with existing IT systems to drive actions but provides platform capabilities to create applications and event handlers that do not already exist in the customer IT landscape.





Cumulocity is designed to accommodate arbitrary vertical IoT applications in addition to its generic functionality. An application can be any combination of a complete application, standalone user interface application, a set of user interface plugins or a set of statements in Cumulocity Event Processing Language. With Cumulocity, users can publish any software to other users or customers.

Tenants can subscribe to applications to get

- Extensions to the Cumulocity user interface
- Entirely new user interfaces
- Branding of the Cumulocity user interface
- New server-side business logic
- Applications and subscriptions.

Applications are registered in Cumulocity either as "own" applications or "market" applications.

"Own" applications are only available to users of a particular tenant and are registered by the tenant's administrator. Own applications are used, for example, during application development when users don't want to make a particular application version available for a wider audience yet. They are also used for functionality that is proprietary for an enterprise, for example, interactions with in-house IT systems.

"Market" applications are available to all tenants of Cumulocity. Subscribing a tenant to a market application makes this application available to the tenant.

Applications are identified by a so-called *application key*. The application key enables Cumulocity to associate a request with one particular application.

An application can be any combination of:

- A complete, standalone user interface application, regardless if based on the Cumulocity UI framework (see below) or any other web components
- A set of user interface plugins
- A set of statements in Cumulocity Event Processing Language.

User interface applications appear in the application switcher widget on the top right of Cumulocity, so that users can navigate between the subscribed applications. They can be hosted on an external website; in which case the application switcher just directs the user to that website. They can also be hosted through Cumulocity, in which case the application will be made available through a URL.cumulocity.com/apps/

2.4 Device Management

Software AG has a particularly strong offering in the growing IoT device management ecosystem.

In particular, Analyst MachNation cited Software AG's unique strengths in the following areas:

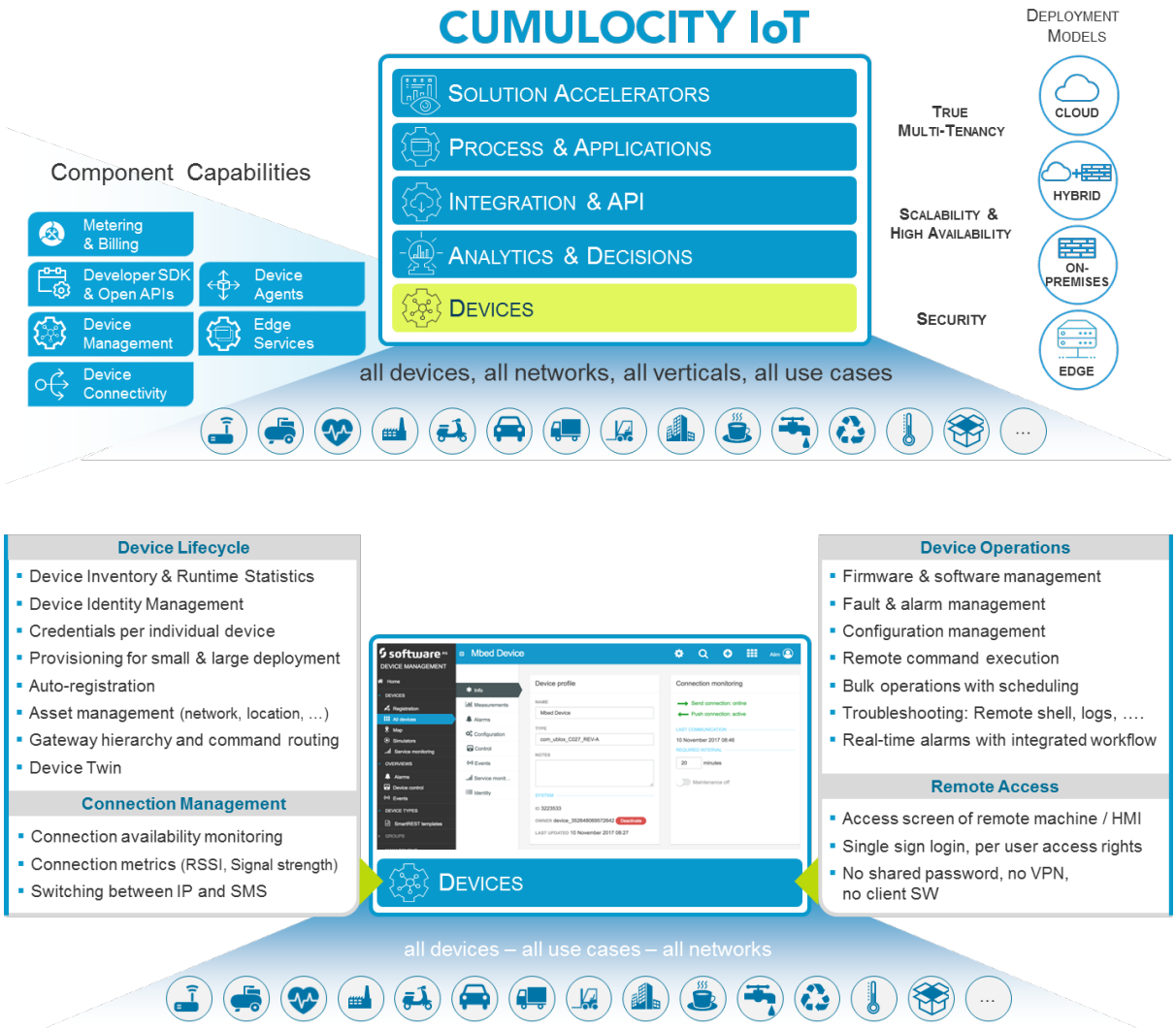
- Excellent device lifecycle management
- Highly extensible device management dashboard, group dashboards and on-platform analytics
- LWM2M support provided alongside ModBus/RTU, ModBus TCP, CAN bus, Profibus, OPC-UA.

Cumulocity provides a highly extensible Device Management dashboard, including recent improvements to group dashboards and on-platform analytics.

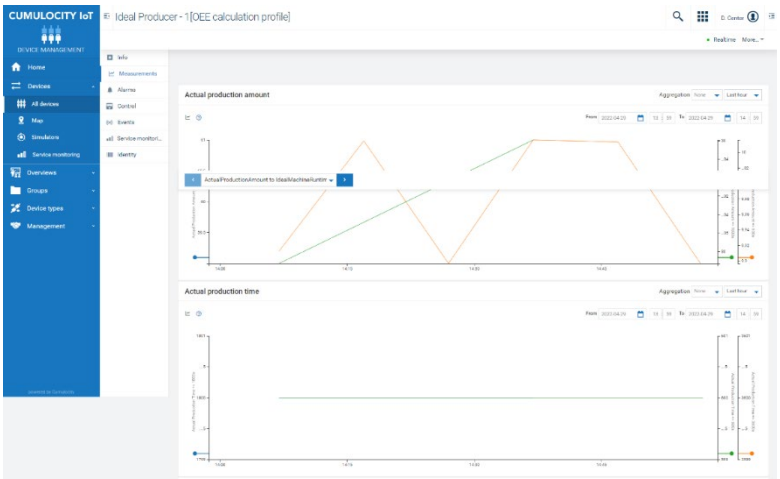
Providing both user and developer interfaces designed for customised alerts and monitoring, Cumulocity IoT enables easy implementation of commonly used operational and monitoring views. Recently released functionality also allows aggregated monitoring views for both dynamically and statically defined device groups, enabling much more efficient at-a-glance monitoring of device status and underlying ingested data points.

In addition, Software AG may provide the underlying code for the out-of-the-box interfaces to customers. This allows customers to rapidly customize for specific use case requirements.

By providing a flexible and capable system of interfaces, customers are able to focus deployment efforts on other aspects of solution deployment, thereby saving time and development resources that might otherwise be dedicated to the development of front-end interfaces.



The level of depth in DEVICE MANAGEMENT may depend on device features. (e.g., if a device does not support remote firmware upgrade, it will also not be available through Cumulocity.) For interfacing devices not yet certified with Cumulocity, the Device Management Library and the REST Developer's Guide is publicly available.



A Device agent is a function that complies with three tasks for a specific vendor and type of devices:

- Agent translates the device-specific interface protocol into a single reference protocol
- Agent translates the specific domain model of the device into a reference domain model
- Agent enables secure remote communication in various network architectures.

Device Lifecycle Management

Cumulocity supports end to end device lifecycle management across multiple protocols, devices, and integrations out of the box

Typical features such as:

- Device onboarding/sunsetting
- Device maintenance
- Remote diagnostics.

In addition, Cumulocity provides excellent, scalable asset management through hierarchical multi-level, and dynamic rule-based groups and mass execution of device lifecycle tasks and device commands.

Connectivity management is also provided on-platform, as are a variety of effective device and aggregate level data monitoring and device status views.

Cumulocity IoT also provides notifications and alerting with on-platform support for notification events and multi-level alarms.

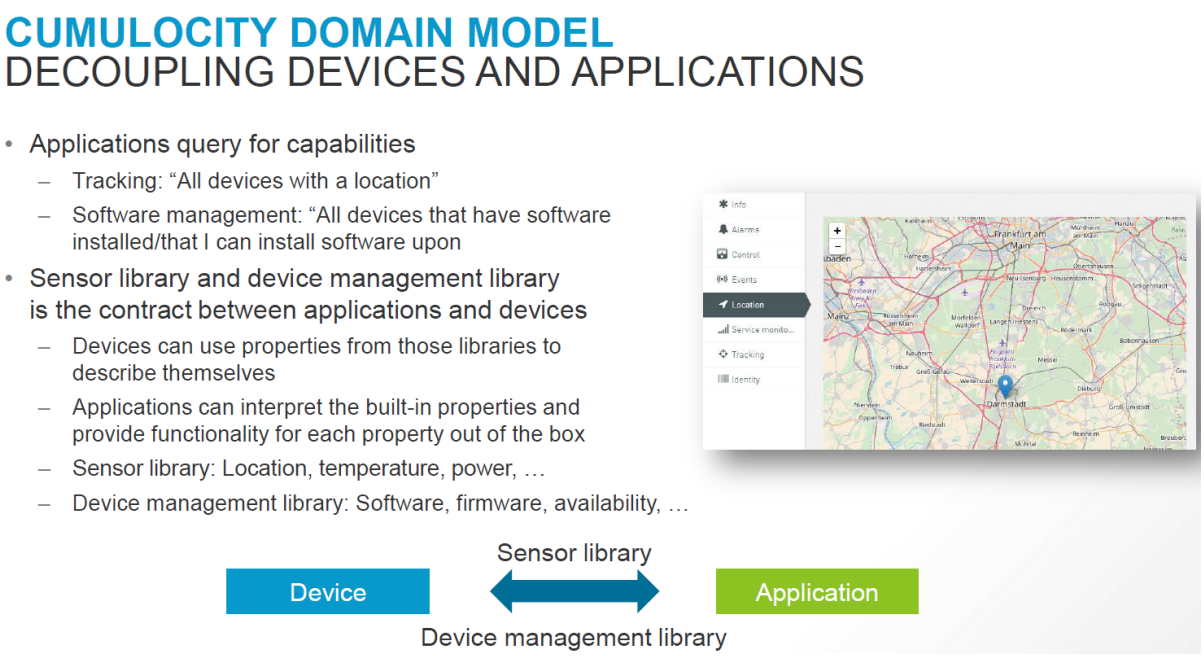
2.5 Cumulocity Domain Model - Inventory

Cumulocity captures all relevant aspects of devices and assets in the Internet of Things.

- The inventory stores all master data related to devices, their configuration, and their connections. It also contains all related assets (like vehicles, machines, buildings) and their structure. Measurements contain numerical data produced by sensors (like temperature readings) or calculated data based on information from devices (service availability of a device).

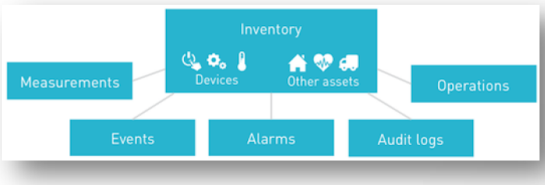
- Events contain other real-time information from the sensor network, such as the triggering of a door sensor. Events can also be alarms. The user or operator of the system has to take action to resolve the alarm (like a power outage). In addition, security-related events are shown as audit logs.
- Operations relate to data that is sent to devices for execution or processing, such as switching a relay in a power meter or sending a credit to a vending machine.
- One of the market leading innovations in Cumulocity is its standardized representation of common devices and sensors as well as concepts for flexibly extending and modifying this representation. By default, Cumulocity comes with detailed visualisations of sensors, smart meters, trackers and other devices. It has many options to fit in local customisations.

USP- As a result, Internet of Things applications can be written independently from connected devices and underlying sensor networks, customized for specific cases in different web configurations or different devices from manufacturers.



CUMULOCITY DOMAIN MODEL
DEVICE AND ASSET INFORMATION

- Data is stored in MongoDB
  - Document oriented NoSQL database where documents are stored as JSON objects
  - Allows a dynamic structure of the underlying data
- Inventory stores all the master data related to devices and related to assets → referred as ***managed objects***



  - **Devices:**
    - Specific device which contains sensors and is able to send measurements to Cumulocity
    - Inventory stores information about their configuration and their connections, e.g. whether the device can be restarted or has a temperature sensor
  - **Assets:**
    - Objects your business focusses on, e.g. buildings and rooms if your business centers around building management or home automation
    - Used to create a logical structure in which devices are located, e.g. a wind farm (asset) consisting of multiple wind turbines (device)
    - Create relations between assets and devices using the inventory

2.6 Managed Objects

Consists of:

- A unique identifier that references the desired object
- A type string that defines the object type
- A time stamp showing the last update
- Additional *fragments*.

Fragments

- Used to describe capabilities, characteristics and the structure of a device or asset in the domain model
  - e.g. if the managed object is a device *c8y_IsDevice* or an asset (group) *c8y_IsDeviceGroup*
  - e.g. if a device is capable of sending its location *c8y_Position*
- Fragments used by Cumulocity start with *c8y_*
- Enhance and describe the characteristics of the managed object by storing corresponding fragments for it
- Built-in sensor fragments: http://cumulocity.com/guides/reference/sensor-library/
- Built-in device management fragments: http://cumulocity.com/guides/reference/device-management/

Measurements

- Contain numerical data produced by sensors (like temperature readings) or calculated data based on information from devices (service availability of a device)
- Measurement has the following structure with mandatory and optional fields
  - Time (mandatory): time of the measurement
  - Type (mandatory): most specific type of this measurement
  - Source (mandatory): the managed object which is the source of this measurement

  - List of the measurement fragments (optional)
- Each measurement fragment is an object containing the actual measurements as properties with following structure:
  - Name (mandatory): name of the measurement, e.g. speed
  - Value (mandatory, used by Cumulocity in the frontend and has to be numerical): the value of the individual measurement, e.g. 25
  - Unit (optional): the unit of the measurement, e.g. km/h
- Free to customize your measurement and the measurement fragments to fulfil your project needs

Events

- Contain other real-time information from the sensor network, such as the triggering of a door sensor
- Events can also be alarms → operator of the system has to take action to resolve the alarm (like a power outage)
- Security-related events are shown as audit logs

Operations

- Commands to be sent to devices for execution or processing, e.g.:
  - Switching a relay in a power meter
  - Sending a credit to a vending machine.

USP – Model-less: Cumulocity's Device Integration approach with its IoT domain model and device service allows to onboard new devices WITHOUT the need to configure the platform, i.e. zero model configuration. This is a key differentiator as it means that a myriad of heterogeneous devices can evolve on a single consolidated platform without a service for one customer affecting another customer.

2.7 Data Model

Data Stream	Attributes
Input streams	• GENERAL STRUCTURE • MANAGEDOBJECT • EVENT • MEASUREMENT • OPERATION • ALARM • RESPONSE RECEIVED
Output streams	• GENERAL STRUCTURE • MANAGEDOBJECTS • EVENTS • MEASUREMENTS • OPERATIONS • ALARMS

Special streams	• SENDMAIL • SENDDASHBOARD • SENDSMS • SENDPUSH • SENDSPEECH • SENDREQUEST • SENDEXPORT
Additional data models	• ID • OPERATIONSTATUS • SEVERITY • ALARMSTATUS

2.8 Multi-Tenancy

Cumulocity IoT supports true multitenancy architecture that serves multiple tenants. A tenant is a group of users who share a common access with specific privileges to a dedicated share of the instance including:

- Data
- Configuration
- User management
- Tenant individual functionality
- Non-functional properties.

https://cumulocity.com/guides/users-guide/enterprise-edition/#managing-tenants

The Enterprise Tenant of the Cumulocity IoT platform provides several enhancements to the features of the Standard Tenant. The following sections describe additional functionalities available in the Enterprise Tenant.

2.9 Managing Tenants

Using the Enterprise Tenant of Cumulocity IoT, users can make use of the tenants functionality which grants the ability to create and a manage SUBTENANTS. In the management tenant, users will also find information on the parent tenant, i.e. the tenant that created the listed tenant.

There is a major difference between providing several tenants and providing several users with different permissions within a single tenant. Tenants are physically separated data spaces with a separate URL, with own users, a separate application management and no sharing of data by default. Users in a single tenant by default share the same URL and the same data space. If an Enterprise's users, for example, are separate Regions/ Areas/ End Customers and User need to strictly separate them because of legal, regulatory or security reasons, Software AG strongly recommends that the Enterprise does so by working with Tenants.

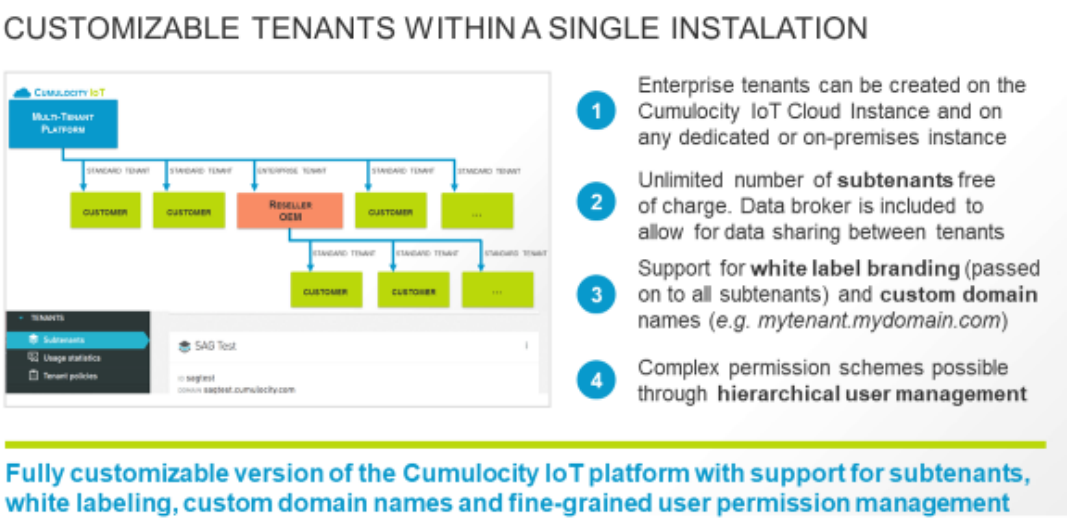
To be able to use the tenant functionality, the Cumulocity user needs to have the appropriate permissions. Creating and editing global roles for information can be done by editing permissions. Since editing tenants is a sensitive operation, permissions for editing tenants are more granular:

- READ: Browse and view tenants
- CREATE: Create new tenants
- UPDATE: Edit tenants (incl. subscriptions) and suspend or activate them
- CHANGE: Create, edit and delete tenants.

The Tenants page provides the following information on each subtenant:

- The name of the subtenant, e.g. company name of your customer
- The ID and domain
- Optionally, a contact name and phone number
- The date when the tenant was created

- The status of the tenant, either active (indicated by a green checkmark icon) or suspended (indicated by a red cross icon)



- Full multi-tenancy concept built into Cumulocity from inception
- No risk of data "leaks" between tenants
- Full subscription model for applications
- APIs for system integration.

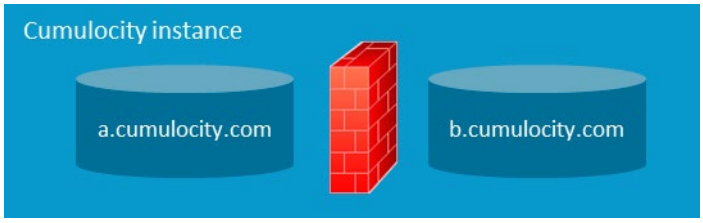
Each tenant has

- Own user and permission management
- Own data storage
- Own applications and system integrations
- No access to data from other tenants.*
- A unique ID and a URL (e.g., <tenant>. cumulocity.com).

By convention, the ID is the first part of the URL.

URL can be arbitrarily changed, but keep in mind SSL restrictions:

- Has to match parent domain for Wildcard SSL (unless user serve other certificates).
- Only one level supported (i.e., <tenant>. cumulocity.com, but not <subtenant>. <tenant>. cumulocity.com)



2.10 Role Based Access Control (RBAC)

2.10.1 Managing users

The user management feature allows Administrator to manage the users within your tenant. With this functionality you may:

- Create users
- Assign usernames and set passwords
- Store user details
- Choose basic login options
- Enable additional login security by using Two-Factor Authentication (TFA).

Info: The user needs to have a role with the user management permission ADMIN or CREATE to be able to do so.

Info: If your tenant is configured for using SSO (Single Sign-On) in SAG Cloud, new users should be created under My Cloud, accessible through the application switcher in the upper right corner, so that they are able to use the SSO feature. For users created in My Cloud, password reset in Cumulocity is disabled.

2.10.2 Managing permissions

Permissions define what a user is allowed to do in Cumulocity applications. To manage permissions more easily, they are grouped into so-called “roles”. Every user can be associated with a number of roles, adding up the permissions and capabilities of the user.

The following types of roles can be associated with users:

- Global roles: Contain permissions that apply to all data within a tenant

- Inventory roles: Contain permissions that apply to groups of devices.

Moreover, application access can be granted to enable a user to use an application.

2.11 Microservices

Microservices are server-side applications. Microservices can be used to develop for example the following functionality on top of Cumulocity IoT:

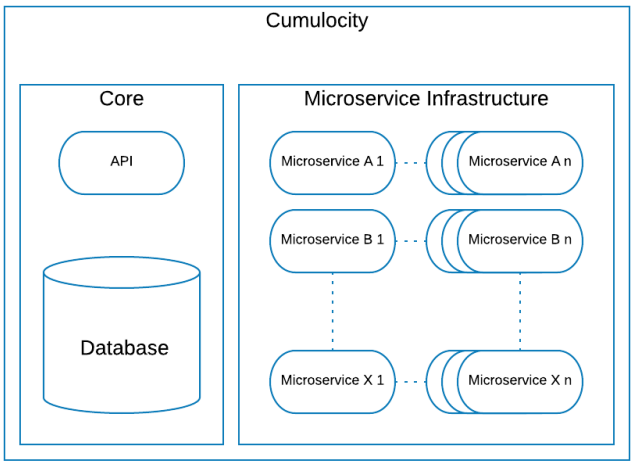
- Integrations
- Batch analytics
- Decoder
- Backend applications.

https://cumulocity.com/guides/concepts/applications/#microservices

Microservices are deployed as Docker images to Cumulocity IoT and follow specific conventions. They typically provide one REST API, which is available under /service/<microservice-name>. They typically access Cumulocity IoT using the documented REST API.

When developing a Cumulocity IoT microservice, a developer is not restricted to any programming language. However, a microservice must serve as a HTTP server working on port 80 and must be encapsulated in a Docker image.

The hosting of the microservice is provided by Cumulocity IoT. This way developers can focus on business logic and leave scaling, security, high availability and monitoring to Cumulocity IoT. Microservices can be built on top of the API exposed by the Cumulocity IoT platform. This way, Cumulocity IoT microservices are a comfortable means to provide new functionality and extend existing ones.



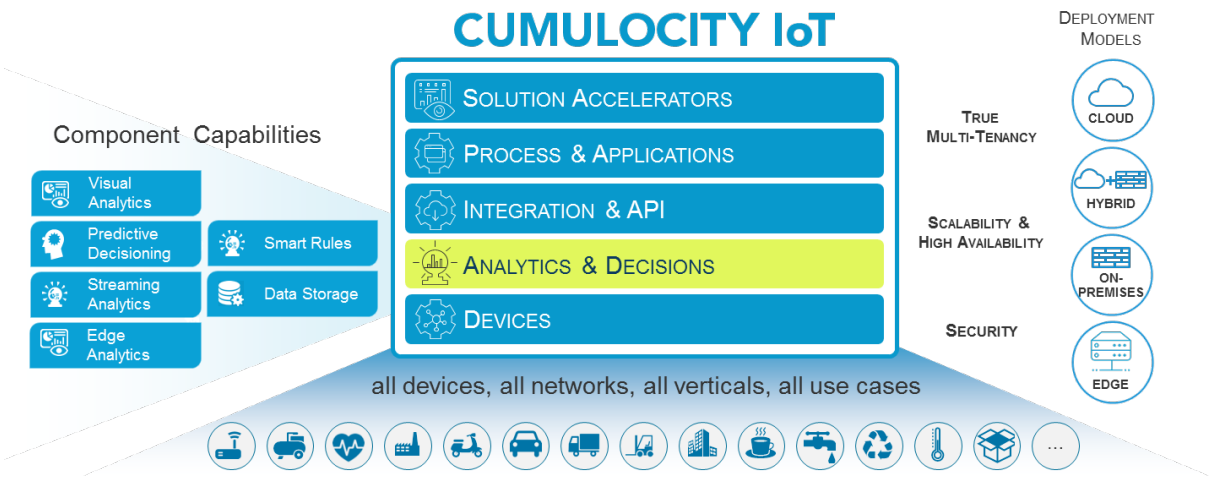
2.12 Real Time Analytics and Decisions

Cumulocity comes bundled with a built in Streaming Analytics engine, Apama, as well as providing Machine Learning capabilities as optional extras. These extras include Zementis, a machine learning engine, as well as Machine Learning Workbench, a machine learning application.

- Apama – the leader in streaming analytics
- Zementis – Machine learning engine
- Machine Learning Workbench – Machine learning application

This enables Cumulocity to ensure performance at a massive scale, essential when connecting to a multitude of devices as well as connecting to a large number of devices (millions).

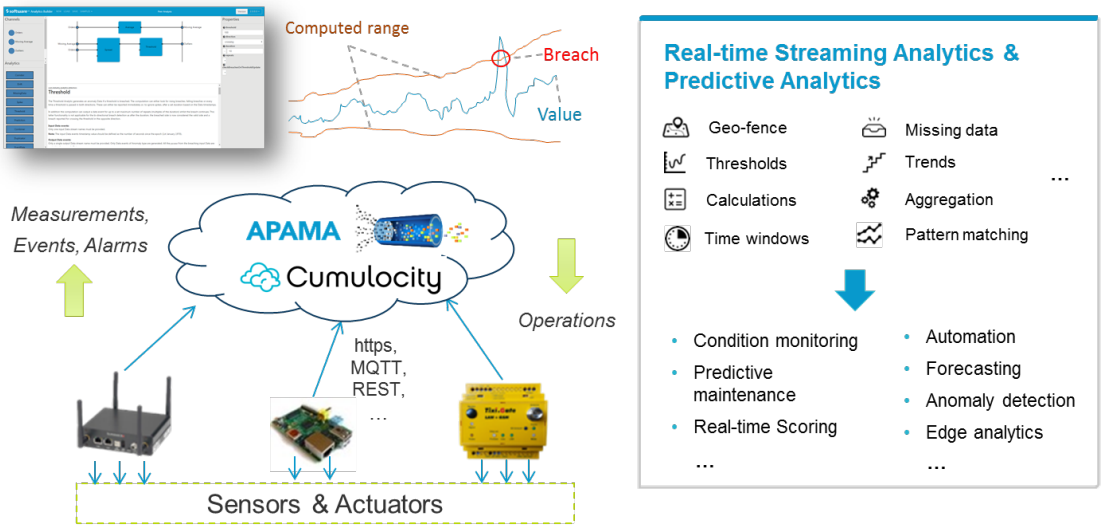
https://cumulocity.com/guides/apama/overview-analytics/#streaming-analytics



2.12.1 Real-Time Analytics - Apama

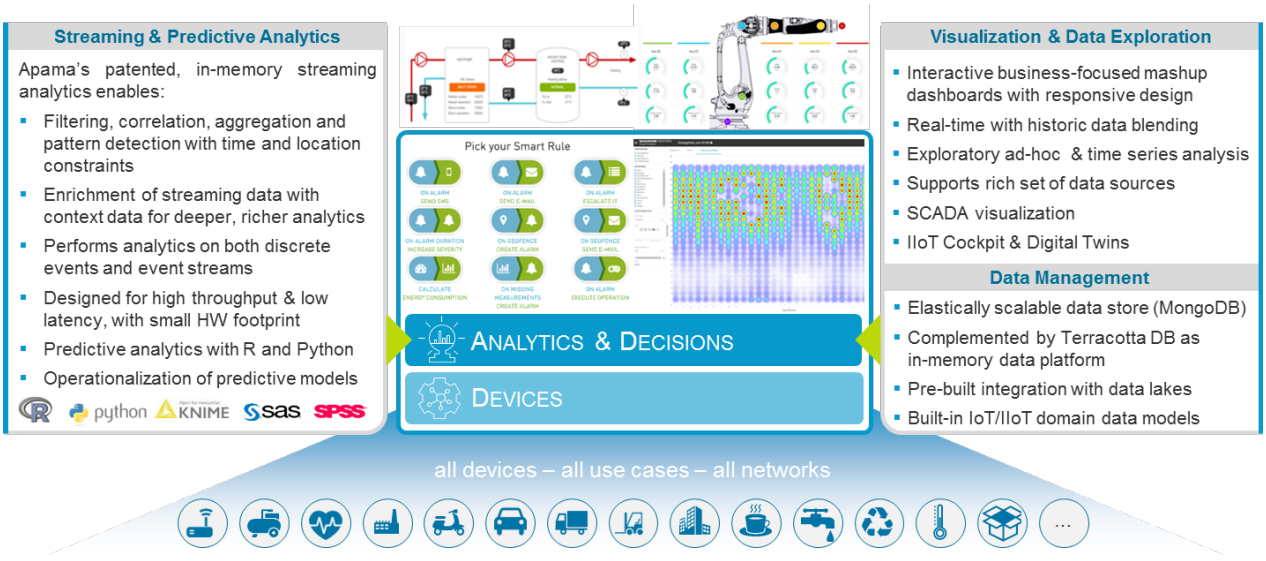
Cumulocity allows developers and power users to run real-time IoT business processes. Users can choose if data is stored on a permanent basis or is temporarily used to generate reports/analytics and then is deleted automatically. The processes and results update continuously. Cumulocity IoT allows Developers and Power users to run real-time IOT business logic inside Cumulocity based on APAMA - a high-level Real-Time Processing Language.

Apama's Event Processing Language covers statements, which are organized into actions and monitors. Monitor files can be edited directly from within Cumulocity IoT using Apama EPL Apps. Alternatively, users can install Apama on your local machine and develop your applications with Software AG Designer - an Eclipse-based development environment. Users can deploy their monitor files as Apama applications to Cumulocity IoT.



Cumulocity's Apama streaming Real-Time Engine receives all data coming from devices or other data sources for immediate processing based on user-defined business operations. These user-defined business operations can alert applications of new incoming data, create new operations based on the received data (such as sending an alarm when a threshold for a sensor is exceeded), trigger operations on devices or send email. This operation logic is implemented in *Apama EPL*, a high-level domain-specific language designed for real-time data.

BUSINESS OPERATIONS logic implemented in Apama's Event Processing Language (EPL) can be defined for immediate processing of incoming data from devices or other data sources. These User-Defined operations can, for example- alert applications of new incoming data, create new operations based on the received data (such as sending an alarm when a threshold for a sensor is exceeded), or trigger operations on devices.



https://cumulocity.com/guides/concepts/realtime/

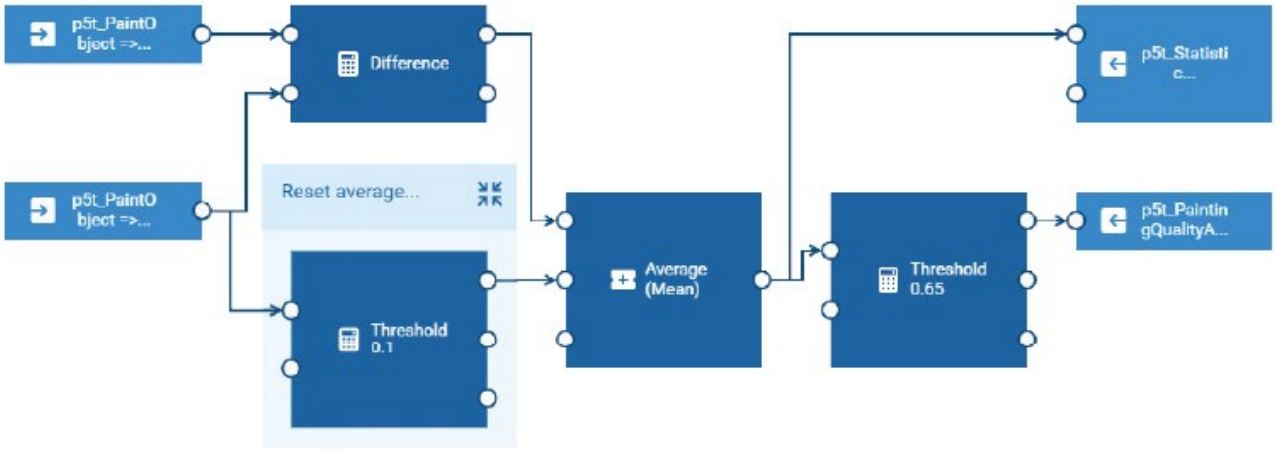
Cumulocity empowers users with Apama's analytical capabilities through the provision of Analytics Builder. Analytics Builder is a tool available for Cumulocity users that provides a low-code interface to harness the power of Apama. With analytics builder users can analyse their streamed data from all their machines and devices without writing a line of code. This allows operational technicians, factory-floor engineers, and analysts to build out analytical models themselves, improving operational efficiencies at a faster rate.

Recognizing and acting on patterns in live data from machines and devices enables you to respond to changing events while you can influence the outcome. Until now, that's been complicated, requiring coding and deep analytics skills to create logic based on many versions of "if this, then that" calculations.

Cumulocity IoT Analytics Builder makes it simple. Anyone can define analytics using easy-to-connect building blocks. The result? Your team can monitor operations, receive alerts for predicted behaviour, and detect problematic scenarios before situations get worse, turning problems into opportunities for rapid improvement.

Using Analytics builder, you can select from a wide-ranging library of prebuilt analytics that you can piece together as blocks within models to:

- Identify threshold breaches
- Calculate averages and standard deviations
- Calculate weighted linear regression gradients
- Discover missing data
- Create custom analytics blocks using the Analytics Block SDK.



Cumulocity IoT Analytics Builder empowers you to build analytics on live, streamed data.

The simulator provided with Analytics Builder makes it easy to test models on historical data before deploying them into production. When a model is fit for production, simply deploy it with a single click and start seeing the analytical benefits within seconds.

The most accessible of Cumulocity's analytical capabilities are Smart rules. Smart rules leverage the Apama analytics engine to provide users with easy to implement analytics through a wizard. Smart rules can be applied to any of your devices or data streams to get intelligent insights from them, by any user of the platform. Some of these capabilities include:

- On alarm send SMS/Email
- On geofence create alarm (Threshold based on devices current location)
- On missing measurement create alarm
- On measurement threshold create alarm

2.12.2 STREAMING ANALYTICS WITH APAMA EPL

Using Apama streaming analytics, users can add their own logic to their IoT solution for immediate processing of incoming data from devices or other data sources.

These User-Defined Operations can, for example,

- Alert applications of new incoming data
- Create new operations based on the received data (such as sending an alarm when a threshold for a sensor is exceeded)
- Trigger operations on devices.

The operation logic is based on Apama's Event Processing Language (Apama EPL).

USE CASES for typical Real-Time Analytics include:

- Remote control: Turn a device off if its temperature rises over 40 degrees
- Validation: Discard negative meter readings or meter readings that are lower than the previous
- Derived data: Calculate the volume of sales transactions per vending machine per day
- Aggregation: Sum up the sales of vending machines for a customer per day
- Notifications: Send me an alerting email if there is a power outage incident in one of my machines
- Compression: Store location updates of all cars only once every five minutes (but still send real-time data for the car that I am looking at to the user interface).

BENEFITS of using Real-Time Processing

Cumulocity's real-time processing feature, enabled by Apama, provides the following benefits:

- React / respond instantly to events from remote sensors
- Develop highly interactive IoT applications
- Run IoT use cases directly inside Cumulocity without software development and leave the hosting and management to Cumulocity

- Validate, normalize and derive data according to own business rules across different device makes
- Trigger automated remote-control actions based on events
- Use powerful, stream-oriented business logic, like time windows and joins
- Reduce the cost of tracking devices, online, by preselecting data necessary for long-term storage.

2.13 Predictive Analytics – Machine Learning

The machine learning capabilities in the Cumulocity IoT platform enable User to deploy and manage machine learning models and custom resources and use them for generating predictions on data gathered from your devices.

https://cumulocity.com/guides/machine-learning/introduction/

These capabilities can be leveraged either from a web browser via an easy-to-use UI (Machine Learning Workbench application) or programmatically via REST API (Zementis microservice).

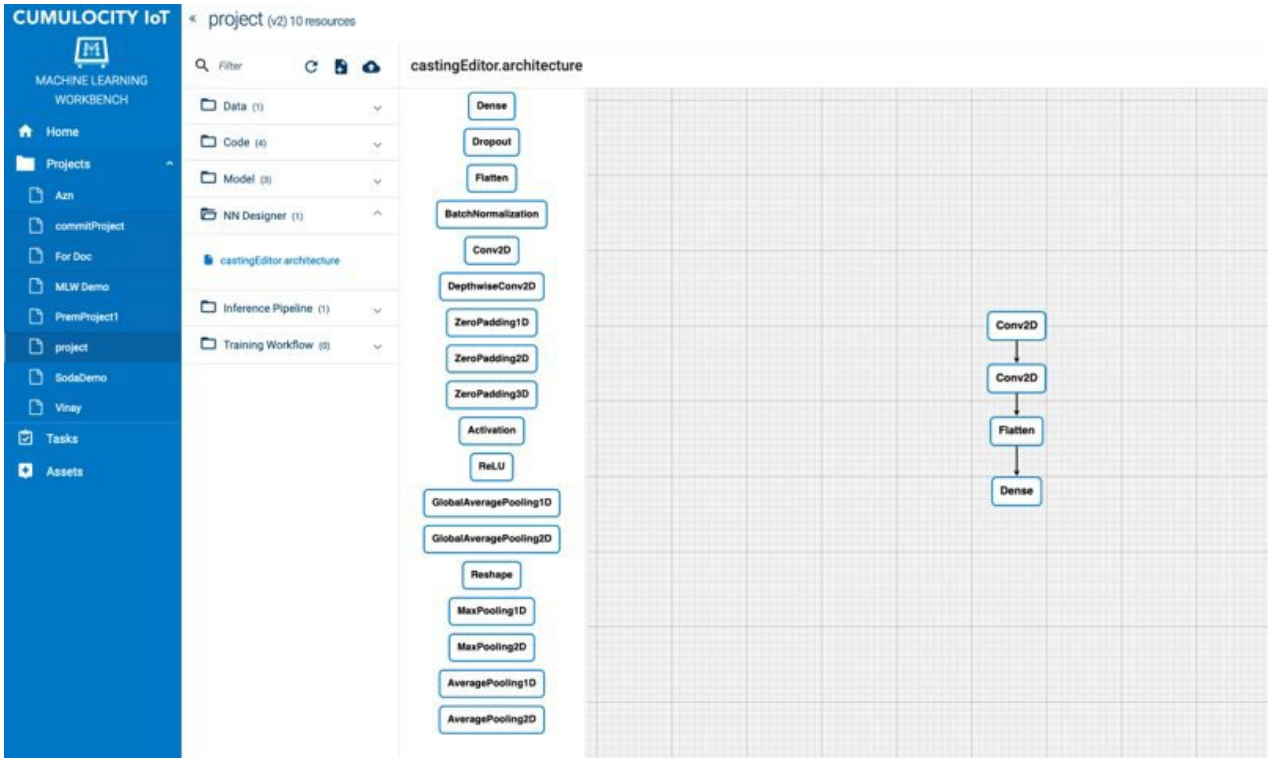
https://cumulocity.com/guides/machine-learning/web-app/

MACHINE LEARNING – MACHINE LEARNING WORKBENCH

The Machine Learning Workbench (MLW) application is available as an additional service for Cumulocity. MLW runs as a microservice on the user's Cumulocity tenant and enables users to manage their models by providing options for uploading, downloading, or activating/deactivating your models. Additionally, it also provides users with an insight into your models by capturing runtime performance and showcasing it via meaningful KPIs. Moreover, it enables users to manage custom resources which your models might need. These resources include custom functions and look-up tables.

Users of MLW can simplify their model training process in multiple ways; Multi-modal model development allows various personas to develop models using their chosen method; Selective artifacts allow for supported project versioning allowing code, models and data to be efficiently shared across the team; Schedule your model's for both training and re-training with the in-built task scheduler; Integrate data seamlessly with data lakes and operational datastores via Datahub, providing flexibility to architecture with your lack of data restriction.

Users of MLW also benefit from a streamlined management of models throughout its lifecycle. MLW is able to provide this benefit through multiple features, one such feature being a one-click model deployment based on ML standards (PMML and ONNX), another such feature is model inference pipeline management for ONNX models.



MACHINE LEARNING - ZEMENTIS

https://cumulocity.com/guides/machine-learning/api-reference/#overview

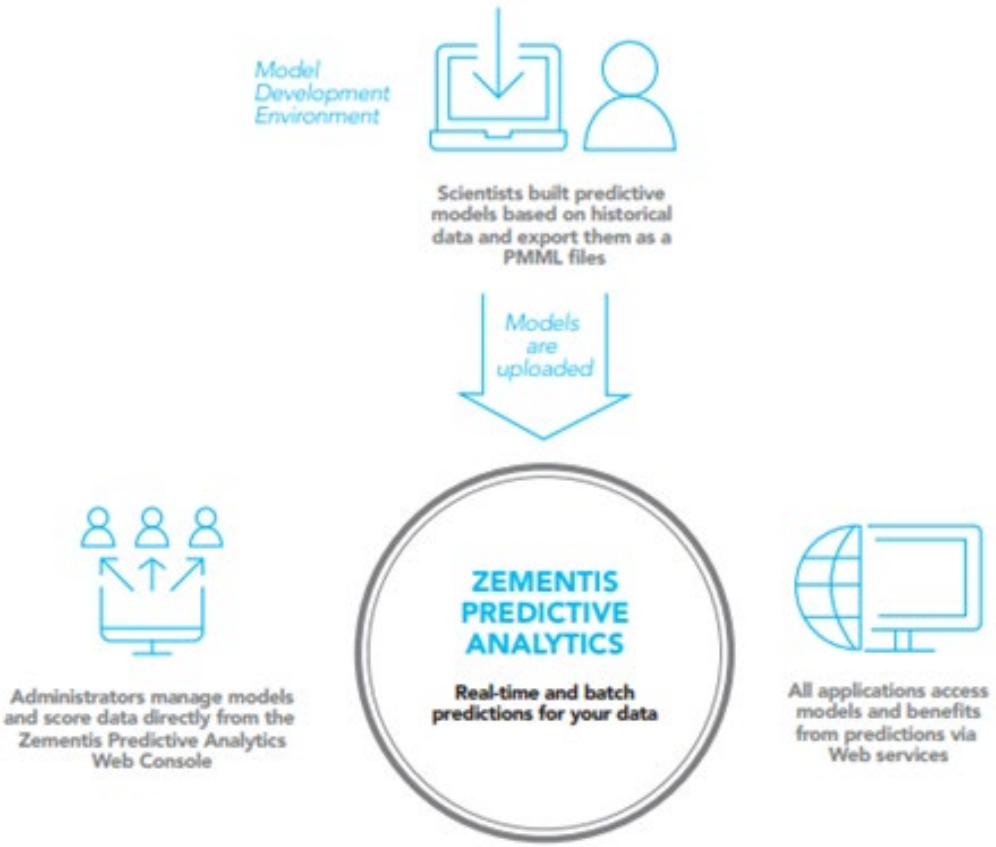
The Zementis microservice API allows users to perform operations on models and custom resources, and process data by issuing a simple request using any HTTP client such as a web browser. Applications that utilise Zementis consume, execute, optimise and scale; AI, machine learning and predictive analytic models represented in the Predictive Model Markup Language (PMML). This capability is available both in the cloud as a microservice for your application, or as a plugin on the edge, allowing you to get insights as close to the data source as possible.

Zementis supports a wide range of techniques used in predictive modelling some of which are:

- Neural network models: back-propagation, radial-basis function and deep learning
- Support vector machines for regression, binary and multi-class classification
- Linear and logistic regression (binary and multinomial)
- Naïve Bayes classifiers
- General and generalized linear.

Zementis also implements myriad other functions for implementing data pre- and post-processing, some of these functions include:

- Value mapping
- Discretization
- Normalization
- Scaling
- Logical and arithmetic operators.



USE CASES for typical Predictive Analytics include:

- Anomaly detection: Send an alert if anomalous data is received
- Pattern recognition: Send an alert if a certain pattern is recognised or starting to form
- Enhancing reliability: Boost equipment reliability with definitive performance knowledge
- Improve uptime: Predict when outages will happen and plan accordingly
- Quality control: Monitor and maintain high quality of products
- Derived data: Make intelligent decisions based on device data.

BENEFITS of using Predictive Analytics:

- Development of intelligent IoT applications
- Reduction in costs
- Improve Efficiency with automatic alerts
- Reduce risk knowing how well assets are performing
- Improve decision making with data allowing for informed decisions
- Faster response time with automatic alerts and remote actions
- Automatic data validation with pattern recognition.

Streaming analytics applications using Apama can make use of the users' models running in the Zementis microservice. A Machine Learning application can be built with the Zementis microservice and similar steps apply to connect to any other microservice running inside Cumulocity IoT.

https://cumulocity.com/guides/apama/advanced/

Users can create a connection to the Cumulocity IoT platform from within Apama EPL which can be used to invoke other microservices directly. Users can then view how to make a request and decode the result. Users can develop an Apama EPL application using the EPL editor (that is part of Apama EPL Apps) and demonstrate communications with a Machine Learning model loaded through the Zementis microservice.

2.13.1 Cumulocity IoT Data Hub

Your Internet of Things solution can generate thousands of data points from thousands of endpoints every day, resulting in huge amounts of historical data. Now there's a powerful way to make sense of it all. Leverage Cumulocity IoT DataHub to make your insights into long-term IoT data more meaningful for better responses and better decision making. You can add Cumulocity IoT DataHub to Software AG's market leading IoT platform to get more from your IoT data.

Collecting and analysing data in real-time allows you to monitor your assets and act on events and data without any delay. Despite this ad-hoc, real-time capability, being able to view your business holistically through historical data analysis provides exponential value - for example, gaining the ability to fine-tune your shipment processes by learning from past shipments or discovering trends to identify devices that may fail soon.

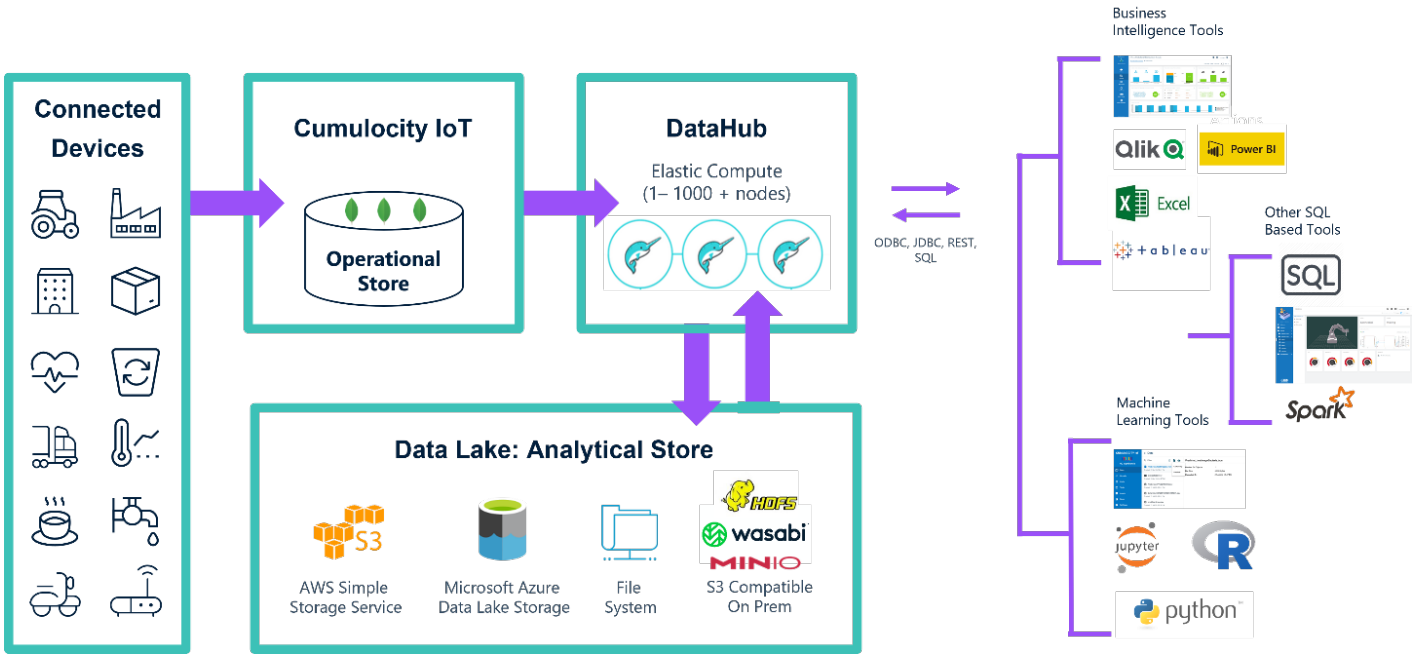
Cumulocity IoT DataHub is designed to:

- Automatically move data from the operational data store into a data lake
- Store flattened data in an analysis-friendly layout
- Execute complex analytical queries at high speed
- Easily scale with the amount of IoT data being processed—one pillar of that architecture is the separation of storage and compute capabilities.

Due to the nature of an IoT solution and its scalable number of devices producing data, a steadfast querying capability needs to be present. DataHub employs SQL – a capability granted by Dremio; SQL remains the lingua franca of data processing for decades. Unleash the power of SQL, and you will quickly convert raw IoT device data into meaningful information. DataHub acts as an integration layer, enabling high-performance SQL queries on your historical IoT data. This data can be utilised in a wide range of business intelligence, analytical applications, machine learning training or other custom applications following standards such as: Arrow Flight, JDBC®, ODBC, REST and SQL.

At its core, DataHub allows you to offload your IoT data into a dedicated data lake of your choice. This analytical store can be hosted on Amazon® Web Services Simple Storage Service – AWS S3 or Microsoft® Azure® Data Lake Storage Gen 2 - ADLS2 to dramatically lower the cost of creating and managing a data lake. In addition to this, self-hosted businesses can utilise DataHub through the use of Cloudera® or Hortonworks® Hadoop® Distributed File System (HDFS) as their data lake.

Cumulocity IoT DataHub is designed as a cloud-native application, with all its components running as microservices/containers in Kubernetes® clusters in private or public clouds. Need local processing? On a shop floor, for example, IoT devices are often connected to local computers instead of remote cloud platforms and do local processing instead of moving all data to the cloud. Cumulocity IoT DataHub serves those use cases by providing an edge edition. As a storage layer, Cumulocity IoT DataHub Edge uses the local storage of the edge device. Other than that, Cumulocity IoT DataHub Edge offers the same capabilities as the cloud edition, excluding horizontal scalability.



2.14 KEY BENEFITS of Choosing Cumulocity IoT for End-to-End IoT Solution

#1 Cumulocity IoT Simplifies Device Integration and Management with a Quick Plug-and-Play Approach

Because IoT solutions are complex system integration projects, multi-disciplinary in nature, bespoke and time-consuming. Cumulocity IoT configures data points and sets them to relevant protocols that facilitate device integration and equipment connections in the shortest time possible. Since Enterprises can connect Cumulocity compatible Devices to get their IoT applications up and running quickly, shortened time to avail status reports, historical data analysis, and log monitoring is significantly shortened.

#2 Cumulocity IoT Enables Self-Service Real-Time System Visualisations and Vigilance

Cumulocity IoT provides system visualisations and remote device configurations by enabling high-capability graphical dashboards. The sensor data is captured and fed into these dashboards, which track Key Performance Indicators (KPIs) and represents performance status of the devices. As a result, enterprises gain visibility into their operational framework and are in greater control to drive timely and substantial improvements in their operations and supply chains. Besides this, Cumulocity provides buttons, text boxes, and drop-down menus to users for remote machine configuration with relevant permissions.

#3 Cumulocity IoT Offers Real-Time Analytics and Proof of Value for Predictive Maintenance

Achieving data intelligence is intrinsic to IoT frameworks and Cumulocity IoT goes a full circle in enabling advanced analytical capabilities within enterprises. The platform delivers service-oriented insights for condition monitoring and forestalling impending damages while allowing enterprises to send real-time commands to devices for cloud-based automation.

#4 Cumulocity IoT Helps in Workflow Management with its Pre-Packaged Device Management Features

Cumulocity IoT turns IoT-enabled devices from assets to manageable smart assets by providing a fully featured set of device management solutions, which help in rapid configurations and expand scalability to an evolving family of IoT devices as and when the project needs arise. Cumulocity solutions are powered by telco-grade features, including software management, alarm management and configuration and performance management.

#5 Cumulocity IoT Accelerates Process Innovation through Enterprise-wide Innovation

Cumulocity IoT is indisputably the fastest platform to connect the real world compatible IoT devices with diverse business applications and get IoT integrations running. Along with opening various structured and unstructured data streams, Cumulocity provides an 'analytics engine' for transforming, mining, and processing of data—a factor that helps enterprises track and trace system performance and execute strategies to accelerate business potential while planning in foresight and reducing the cost of change.

3 Information Assurance

Software AG's cloud infrastructure is provided by Amazon Web Services (AWS), an ISO 27001 certified third-party vendor, Microsoft Azure is also available on request for cloud infrastructure. Cumulocity IoT Platform is deployed as a public cloud, multi-tenant concept where customers share central resources but are virtually segregated. Physical access to AWS data centres is strictly controlled and audited according to their ISO 27001 and SOC 2 Controls.

Software AG's Cloud Operations Team will manage your solution according to our ISO 27001 and SOC 2 Controls. This includes security testing and policies and annual penetration testing and patch management. Access by Cloud Operations Staff is strictly controlled. Cumulocity IoT Enterprise can be hosted in any AWS or Azure hosting location e.g., UK.

4 Backup/Restore & Disaster Recovery Provision

An automated tenant backup process is established and performed Daily, with five days rolling backups. Backups are securely stored on Amazon S3 and provide restore and recovery capabilities, which can be utilised by Cloud Service Operations if necessary. Additionally, each Amazon EBS volume is automatically replicated within its AWS Availability Zone to protect it from component failure, offering high availability and durability. Recovery Point Objective (RPO) is 24 hours based on daily backups; Recovery Time Objective (RTO) is 12 hours.

Cloud Service Operations has a Disaster Discovery plan and procedures in place for cloud services and each disaster recovery plan is tested by Cloud Service Operations and reviewed by Cloud Security, Compliance and Certifications on a yearly basis and in alignment with ISO 27001 standards.

5 On-Boarding & Off-Boarding Processes

5.1 On-Boarding

Customers will receive a counter-signed Cloud Services Agreement which will include information on security, availability, SLAs and product specifications for reference. A welcome email will be received containing the link to register your cloud tenancy in the region selected. Customers are responsible for creating their initial tenancy (a simple online process) and returning the name of their sub-domain back to Software AG, who will then complete the set up. Once the tenancy has been created, an automated email will be received containing all information necessary to access the cloud tenancy.

Valid licences are supplied, typically via email which also contains full instructions required to access support for the Software AG products. Valid Software AG software licences entitle the end user to full support in terms of product support and upgrades. Support provision is detailed in Section 6.4 of this document. Technical implementation is the sole responsibility of the end user. To accelerate the implementation process, bespoke training and education packages are available at extra cost.

The exact nature of provisioned training and education is subject to negotiation, as detailed below. Professional Services are also available to assist with and to expedite the implementation of end user solutions and to provide on-site support. Professional Services are provided at extra cost. The exact cost of additional Professional Services is subject to negotiation, predicated on the scope of the assistance required.

5.2 Training

Education Services offers a wide range of education and certification solutions targeted to all cycles of the project chain and across all our different technologies. You can learn to maximise the features of Software AG products with hands-on experience and education provided by our Education Services team.

Train in a public classroom or remote/virtual classroom, private training at your site or remote/virtual classroom. We can even customise a training program to meet your specific needs and goals, and to accelerate your project's success. Take a closer look at the services we can offer your organisation. Please review our complete course catalogue.

Members of the Education Services team can support all requests to create the right education solution for the chosen environment, including user needs analysis and training plan development.

5.3 Off-Boarding

Upon expiry of the contract term, Software AG's Cloud Service Operations will retain the latest state of a tenant, including the latest tenant backup, for 30 calendar days. Upon request, backup data can be provided to cloud customers. After the designated holding period is over, customer data will be destroyed in accordance with the Cloud Service Agreement and AWS US Department of Defence (DoD) standards.

6 Security

Security is an important aspect of everything we do, both for the Cumulocity IoT Platform as well as for our customers, some of whom operate in heavily regulated industries. It is vital that Cumulocity IoT runs with the highest possible security posture to support and conform to our customers' security requirements. The Cumulocity cloud product is a single tenant cloud service that is fully segregated from other customer tenants (domain, network, server, and database). Single tenant cloud services have strong tenant isolation security and control capabilities.

Compliance and Standards

Cumulocity is a leading IoT application in the software market and is compliant to a number of certifications and standards. Cumulocity is compliant with several ISO standards such as ISO 27001 and is audited on a yearly basis.

ISO is a widely recognised international security standard which specifies security management best practices and comprehensive security controls. The development and implementation of an Information Security Management System (ISMS) is the foundation of this certification. This system is necessary to manage sensitive company information so that it remains secure. Software AG Standard Cloud Services and Managed Cloud Services is in compliance with:

- ISO/IEC 27001:2013
- ISO/IEC 27017:2015
- ISO/IEC 27018:2019

Software AG's implementation of, and alignment with, ISO 27001 for cloud services demonstrates a commitment to information security at every level of the organisation. Software AG is assessed by an independent third-party auditor to validate alignment with the ISO standards. Compliance with these internationally recognised standards is evidence that the Software AG cloud security program is comprehensive and in accordance with industry-leading best practices. The platform has also been assessed using the Data Privacy Impact Assessment and is compliant with GDPR guidelines.

Device Certifications

Cumulocity supports authentication through device certifications (X.509) out-of-the-box. You can upload certificates to uniquely authenticate each device on the platform. Cumulocity supports secure X.509 PKI for device communications over MQTT. Users can upload the certificates to the platform as a base key and then use the certificate chain to authenticate the device. You also have the choice to then revoke that base key and upload another. Cumulocity can also be configured to trust a root certificate, which allows all the devices presenting that certificate to be able to connect to the platform without further authentication.

Security Assessments

Users often want to know details on testing carried out for Cumulocity IoT. The back-end code of the platform itself goes through Static Application Security Testing (SAST) using enterprise grade security code analysers as part of the standard R&D process for every build.

Software AG also has a dedicated security team and a streamlined process for security testing. Rigorous penetration testing is carried out and vulnerabilities are covered as part of the testing plan, these can be found in the OWASP Top 10, SANS 25 and CWE list. There are two types of penetration testing performed by Software AG. This consists of application and network penetration testing conducted by a skilled internal team. For application testing, Dynamic Application Security Testing (DAST) tools are used. This security testing will also include verification of bug fixes which will undergo further security verification before the changes are released. If customers would like to run their own penetration tests, then permission from

Software AG will have to be requested first before doing so. On top of this, Software AG facilitates internal and external hackathons on a regular basis, where internal experts and external vendors evaluate our products' resilience.

Infrastructure

Security is also an important factor when it comes to the environments that Software AG hosts. Software AG hosted Cumulocity IoT Platforms are integrated with Trendmicro Deep Security protection modules which includes an Intrusion Prevention module that inspects the inbound and outbound traffic to detect and block any suspicious activity. This prevents any exploitation of known and zero-day vulnerabilities. The Trendmicro modules also includes an Anti-Malware module which helps protect Cumulocity against malicious software such as malware, spyware, trojans etc.

Patches are routinely performed on the Cumulocity IoT platform on a weekly basis. This includes System Security Patching on Dedicated and Public cloud environments. This does not result in any downtime for the system.

For further information on Cumulocity IoT Security please see:

https://cumulocity.com/guides/concepts/security/

IoT Security Solution | Cumulocity IoT | Software AG

7 Service Management Details

7.1 Support Boundary

Software AG Cloud Service Operations is responsible for the support of the application, database and operating system.

Our IaaS provider AWS is responsible for all physical assets provisioned for Software AG Cloud Services and for the virtualisation layer support.

7.2 User Authorisation & Roles

This is documented in the Cloud Service Agreement and in the product and/or customer on-boarding information.

Software AG administrative access to the cloud infrastructure is managed by a single network access control gateway. Cloud Service Operations engineers connect to the gateway's web application front-end through HTTPS and utilise multi-factor authentication. Setup is configured in compliance with the concepts of need-

to-know and least privilege. Software AG Cloud Service Unit enforces segregation of duties through user defined groups to reduce the risk of unauthorised access or change to production systems. Access to cloud systems is restricted based on the user's job responsibilities.

7.3 General Support Details

All Cloud solutions are covered by Software AG's Standard Support Agreement. Support issues should be raised through Software AG's customer service portal, Empower, which is available 24x7. Three levels of support are available, with standard support offering 24x7 access to the support portal, 9 to 5 telephone support for standard and critical incidents and 24x7 support service for crisis incidents.
We have standard support response times based on the level of severity (standard, critical or crisis) of the issue and these are clearly documented in our Cloud Standard Support attachment.

For more tailored support, clients can select a Managed Service option whereby the SLA's and response times are configured in accordance with their requests. This service can include aspects such as Technical Account Manager, Capacity Management, and any other service the client might want to add. The fee for the managed service is determined by the service required.

In Addition, Software AG has a Security Incident Response Programme, which Cloud Security Operations will enable during Cloud Security incidents.

8 Service Constraints

8.1 Planned Maintenance

All changes to production cloud services, including software updates, application/product changes, and virtual infrastructure changes are planned, evaluated, tracked, implemented and verified based on an established change management process. All such changes are documented through an electronic tracking system. The times of maintenance and upgrade windows are mutually agreed with the customer.

8.2 Emergency Maintenance

Within Software AG's Change Management procedures an Emergency Change is a change that must be implemented as soon as possible, for example to resolve a major incident (i.e. Severity 1 or Severity 2 security incidents) or implement a critical security patch. These Emergency changes are of such a high priority that it bypasses our formal group and peer review process and goes straight to the Authorisation state for approval by Cloud System Owner and Head of CSO.

9 Service Levels

Availability: 99.9%; 5 min intervals per calendar month; excluding standard scheduled maintenance.

Software AG Cloud Service Operations is responsible for the support of the application, database and operating system. Should you need to contact us, you can do so via our support portal and/or by telephone. You will be provided with support portal login details and telephone support details as part of the onboarding process when you subscribe.
Details of our support service are described in section 6.4 (General Support Details). We do not currently offer service credits.

10 Ordering & Invoicing Process

Ordering Process: The first step in the ordering process is to contact us at **uk-gov-digital@softwareag.com** to discuss your requirements and objectives.

When an enquiry or order is received via the G-Cloud procurement service the Software AG Account Manager will engage with the customer contact to ensure that the appropriate software, functions, training and services are selected to meet your needs: we will assist you in placing the order via the G-Cloud Procurement system.

Once the order activity has been completed the customer will receive an electronic Order Attachment listing the individual components of the service which they will need to sign and return with a purchase order. Upon

receipt of those the Software AG Order Processing team will process and provide access to the customer environment on appropriate cloud infrastructure. The Account Manager will be engaged with you throughout the whole process to ensure a smooth and successful project delivery.

Invoicing process: Once requirements have been identified & pricing agreed, the customer will receive an agreement / Order Form / Software Attachment to sign (in PDF format with electronic Docusign countersigning), which must be returned with a purchase order.

We will then invoice the customer in accordance with the signed agreement and use the instructions on the PO to submit the invoice for payment.

11 Termination Terms

Generally, the minimum duration of the SaaS (Software as a Service) period is 12 months payable in advance. Software AG we can offer up to 3-year terms on request.

At the expiration of each SaaS period, all licenses will automatically renew for additional 12 months, unless either party gives the other party notice of non-renewal generally 3 months before the end of the relevant period. Upon renewal the SaaS Fee shall be increased by CPI index variation during the previous term.

If the customer elects not to renew the SaaS license, the license grant and access to Product Support & Maintenance Services and Hosting Services will expire at the end of the applicable period.

12 Data Processing & Storage Locations

Data storage is managed within the Cloud using Infrastructure provider AWS services. Customer tenant data-at-rest is encrypted with AES-256 by utilising AWS KMS server-side encryption. For the IaaS provider AWS this covers the following locations - EC2, S3 and RDS.

Customers designate in which predefined AWS Region their data and servers will be located. The data storage location can be selected when ordering the service.

13 Data Restoration & Service Migration

The solution can be restored from backup as described in section 3 (Backup/Restore & Disaster Recovery) of this document.

At end of contract, a customer can extract data to assist with migration to another solution as described in section 4.2 (Off-Boarding) of this document,

14 Customer Responsibilities

Customer responsibilities will be outlined in the Cloud Service Agreement document. These responsibilities include:

- Use the software in accordance with the licencing and confidentiality restrictions set out in the relevant Cloud Services Agreement and the applicable Order Form
- Carrying out the necessary steps as described in section 4.1 (On-Boarding) of this document
- Maintaining access permissions for customer users and administrators
- Providing information to Software AG to facilitate investigation of support instances
- Access to the solution via up-to-date browsers as described in section 16 (Browsers) of this document.

15 Technical Requirements

This is a cloud solution. There are no technical requirements for the customer other than access via a suitable browser (see next section) and providing suitable network access and firewall rules for connection to the solution.

16 Browsers

Supported browsers:

- Internet Explorer 11.x
- Microsoft Edge
- Mozilla Firefox ESR 60
- Google Chrome
- Apple Safari (desktop only, not mobile)

17 Trial Service

Customers can access a free 30-day trial of all our Cloud solutions on our website.
https://www.softwareag.com/corporate/products/downloads/free_downloads/default.html

18 ICT Environmental Compliance

Software AG makes all efforts to comply with the latest legislation on Environment Impact and will work with buyers to ensure that they are meeting their Carbon Reduction Targets. Software AG's commitment to compliance with Environmental Strategy and Policy is listed below: The development of software does not create a significant environmental impact; Therefore, our industry is not comparable to producing units, nevertheless we monitor facts around, energy consumption, waste management & carbon footprint. Software AG does not maintain an environmental Management System.

However, with its products and services for digitalisation and improved process efficiency, Software AG provides its customers with access to the opportunities of the digital world, which often goes hand-in-hand with saving resources as well as reducing environmental impact.

Environmentally friendly services and products are a core element of Software AG's sustainability efforts, for example: Royal Dirkzwager, a leading global provider of maritime services and information, with headquarters in the Netherlands uses Software AG's Apama streaming analytics solution to gather shipping and weather data and analyses it in real time. It can process more than 1,500 messages per second. The ability to process huge data volumes extremely quickly has enabled Royal Dirkzwager to penetrate new markets, reduce costs and optimise processes. The company's customers use the information to plan and synchronise their activities to cut costs and optimise resources such as fuel. This leads to an enormous reduction of CO2 emissions.

19 ICT Strategy Policy Compliance

Information Security and Data Protection

As a provider of maintenance, cloud and consulting services, Software AG works with sensitive customer data and thus acts as a processor. Software AG also manages sensitive information about its own business, employees and customers, prospective customers, partners and suppliers and is responsible for that data in this role.

The Company is legally required to protect this data while the number of external hacker attacks is constantly rising. The spread of cloud computing also increases vulnerability to data hacking. Software AG's order processing agreements with customers guarantee compliance with data protection laws, particularly with the European Union's general data protection regulation (GDPR).

Significant investments are necessary for ensuring the necessary level of data protection. Penalties of up to 4 percent of Software AG's total annual revenue can be issued in the event of infringements against these laws. Software AG counteracts these risks by implementing a data protection management system which can define processes and guarantee information security and data protection. The Company's order processing agreements contain limitations of liability in the event of data loss. Complete IT security can never be guaranteed.

The following security risk reduction measures are therefore undergoing constant improvement:

- Continuous monitoring of risk factors and expansion of data security through systematic data security strategy
- Implementation of early detection system for data breaches
- Disciplined execution of defined emergency measures in the event of an attack or system failure

- An ISO 27001-certified information security management system (ISMS) was instituted for cloud business customers
- Internal data security guidelines and standard processes, a data security committee and an IT security organisation were established to monitor internal Software AG IT data security and develop data security measures as well as guidelines on an ongoing basis
- Other legal risks - Regulatory, compliance and litigation risks.

Regulatory and political changes, such as embargoes, can influence business operations in difference national markets. That could have a negative impact on the Group's future business and financial performance. Uncertainties regarding regional legal systems could hinder or prevent the assertion of Software AG's rights (e.g. commercial property rights).

A multinational software company like the Software AG Group is subject to global risks associated with legal disputes and government and official processes. Software AG cannot rule out that litigation and proceedings will have negative effects on the earnings of the Company; as a rule, the Group's financial position can even be negatively affected when law suits are won, given the high cost of defence attorneys and other defence services needed to thwart accusations, for example in the U.S. Despite detailed risk assessment and forward-looking risk provisions, there is a risk that the actual cost of litigation is higher than the assumed risk value.

20 Service Pricing

	Basic	Advanced	Enterprise
BEST FOR	Innovation teams and SMEs looking to rapidly deliver enterprise grade IoT services	Enterprises looking for a fully rebrandable IoT platform-as-a service for enterprises or consumers	Enterprises that require full control and oversight of their IoT platform architecture and operations
BASE PRICE	100€/month	Contact us	Contact us
PRICE PER DEVICE (SEE DEVICE CLASS PRICING BELOW)	0.5 - 500€ /month	0.3 - 300€ /month (Volume discounting available)	0.3 - 300€ /month (Volume discounting available)
DEPLOYMENT	Public cloud	Public cloud	On premise or Dedicated cloud

Please visit the Cumulocity pricing page for more information.

21 About Your Company & Services

Software AG is the industry's leading independent integration, Internet of Things, analytics, process software and services company. We are trusted by over 70% of the world's top 1,000 enterprises and many government departments and agencies in the UK and worldwide. Software AG transforms your business and drives enterprise innovation by helping you connect and integrate everything, from applications and devices to data and clouds. We help you free data, even data in motion, from silos to "democratise" it and make it shareable across your organisation, any time it is needed, anywhere and by anyone.

The information on which effective government service delivery depends is often split across a range of disparate systems and application delivery technologies. The Software AG solution allows on-premise or cloud-based applications and data to be blended with ease to support the provision of better, lower delivery cost services.

Software AG's iPaaS is designed to provide the foundation upon which government departments and agencies can seamlessly add innovative capability without heavy customisation of existing and future applications. Our software is a tightly integrated, loosely coupled suite of products that can be combined to fit government departments and agencies requirements. It can be used to create a standard, secure abstraction layer to easily connect, collect and feed data to cloud platforms, analytics tools, data warehouses, operational authorities, government agencies and external business partners. Our software provides the necessary backbone to effectively capture, transfer, mine, analyse and govern data.

We give you the freedom and flexibility to connect and integrate any technology, from app to edge, to unlock the power of your data. We constantly seek new ways to empower our customers through integration, APIs, analytics, the Internet of Things and business transformation software that enables you to outpace your rivals

and lead your industry. We offer you freedom as a service - to give you choice, agility and a leading edge. Software AG has more than 4,700 employees and is active in 70 countries.

21.1 Case Studies

Software AG has experience implementing ICT and IoT solutions which comprise the Digital building blocks to enable Smart Cities.

Smart city applications delivered by Telia on the Cumulocity platform as part of the EU Horizon 2020 programme (SmartEnCity).
https://vimeo.com/214516966

Smart city applications delivered by Telstra on the Cumulocity platform in the city of Joondalup, Western Australia.
http://www.zdnet.com/article/telstra-announces-smart-city-plans-for-western-australia/
https://www.youtube.com/watch?v=Hgzm8EF6Ezc

Software AG IoT Solutions can be deployed on premise, in the cloud and edge deployment scenarios. Software AG customers include over 70% of the world's top 1,000 enterprises and many government departments and agencies in the UK and worldwide, who rely on our solutions to optimise their mission-critical systems.
With the modularity and configurability of Cumulocity platform, our customers can tailor our solution to meet their unique requirements and use cases across a variety of industries. Below are some IoT Case Studies.
Lyreco Customer Story | Cumulocity IoT | Software AG
Deutsche Telekom Customer Story | Enterprise Digitalization (softwareag.com)
Sensor Technik Wiedemann Customer Story | Cumulocity IoT Platform (softwareag.com)
Quenching a thirst for IoT in Australia with Cumulocity IoT and webMethods (softwareag.com).

Additional UK Resources on Smart Cities:

BSI	The UK Department of Business, Innovation and Skills commissioned BSI to develop a standards strategy for Smart Cities. This strategy aims to accelerate the implementation of Smart Cities and minimize the risks of failure in April 2012. The strategy outlines a foundation of knowledge to help cities as the embark on a programme to become smarter: 1. BSI PAS 180 Smart Cities – Vocabulary 2. BSI PAS 181 Smart City framework – Guide to establishing strategies for smart cities and communities 3. BSI PAS 182 Smart City Data Concept Model 4. BSI PD 8100 on Smart City Overview – a guide for city managers 5. BSI PD 8101 Smart cities – Guide to the role of the planning and development process 6. BS 8904 Guidance for community sustainable development provides a decision-making framework that will help setting objectives in response to the needs and aspirations of city stakeholders 7. BS 11000 Collaborative relationship management

21.2 Contact Details

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